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Crowd Confrontation and Non-Lethal Weapons

A literature review and conceptual model

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Defence R&D Canada – Valcartier
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Abstract

This technical memorandum is written in the context of the Crowd Control Modelling and Simulation Capability Technology Investment Fund Project. It presents a comprehensive literature review in the area of crowd confrontation involving non-lethal weapons, covering three areas that are essential to understand such systems. First, several aspects related to crowds were reviewed. They include crowd-specific definitions, phases of crowd development, psychological aspects and a list of determinants of crowd violence. Second, control forces doctrine documents concerning crowd confrontation missions were summarized to provide a better understanding of the objectives, modus operandi, equipment and legal considerations characterizing these missions, both from a military perspective and from a police perspective. Third, the area of non-lethal weapons was explored, including an enumeration of the types of non-lethal weapons and their areas of application, as well as an identification of some of the challenges that still exist in this domain.

In addition to the literature review and based on it, an original model for the behaviour of an individual in a crowd in the presence of control forces was developed. This conceptual model is an attempt to link together into a coherent structure those variables that were identified by the literature review as significant factors influencing the behaviour of individuals in a crowd. The model is proposed as a starting point for the future research efforts of the team aiming to build a crowd control modelling and simulation tool.

Résumé

Ce mémorandum technique est rédigé dans le cadre du projet de Fonds d'investissement technologique qui s'intitule: Modélisation et simulation du contrôle des foules. Ce mémorandum présente une revue exhaustive de la littérature sur le contrôle des foules impliquant des armes non létales et couvre trois sujets essentiels pour comprendre de tels systèmes. Premièrement, plusieurs aspects liés aux foules, tels que des définitions spécifiques des foules, les phases de développement d'une foule, les aspects psychologiques et une liste des déterminants de la violence des foules, ont été étudiés. Deuxièmement, un sommaire des documents de doctrine sur le contrôle des foules est présenté afin de fournir une meilleure compréhension des objectifs, des modus operandi, de l'équipement et des aspects juridiques qui caractérisent ces missions et ce, d'un point de vue militaire et policier. Troisièmement, les armes non létales sont étudiées c.-à-d. qu'une énumération des types d'armes non létales et leurs champs d'application ainsi qu'une identification de certains défis qui existent encore dans ce domaine sont présentés.

De plus, sur la base de cette revue de la littérature, un modèle original du comportement d'un individu dans une foule, en présence des forces de contrôle, a été développé. Ce modèle conceptuel tente de relier dans une structure cohérente les différentes variables identifiées dans la revue de la littérature comme facteurs influençant significativement le comportement des individus dans une foule. Le modèle est proposé comme point de départ pour les futurs efforts de recherche de l'équipe qui visent à bâtir un outil de modélisation et de simulation du contrôle des foules.

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Executive summary

Crowd Confrontation and Non-Lethal Weapons: A literature review and conceptual model

A. Frini; L. Stemate; G. Toussaint; S. Larochelle; R. Lecocq; DRDC Valcartier
TM 2007-488; Defence R&D Canada – Valcartier; March 2008.

Crowd control is a function traditionally associated with the police more than the military. However, there have been situations in the past when Canadian Forces have had to intervene in riot situations during peacekeeping operations, for example in Drvar, Bosnia, in April 1998. The Canadian Forces thus have a need to understand crowd behaviours and to define proper intervention strategies for crowd control. Some lessons learned from riots and other crowd control situations can also be useful to develop procedures to deal with small to moderate gatherings of civilians that often surround military personnel and vehicles during operations.

This technical memorandum is written in the context of the Crowd Control Modelling and Simulation Capability Technology Investment Fund Project. This project aims at studying crowd dynamics with the use of numerical simulations, and at evaluating the impact of the use of non-lethal weapons in crowd control situations. It is intended that the conceptual model underlying the simulations will include psychological and physical factors that affect crowd behaviours, as well as representing control forces strategies and tactics.

This memorandum presents a comprehensive literature review in the area of crowd confrontation systems involving non-lethal weapons, covering three areas that are essential to understand such systems. First, several aspects related to crowds were reviewed. They include crowd-specific definitions, phases of crowd development, psychological aspects and a list of determinants of crowd violence. Second, control forces doctrine documents concerning crowd confrontation missions were summarized to provide a better understanding of the objectives, modus operandi, equipment and legal considerations characterizing these missions, both from a military perspective and from a police perspective. Third, the area of non-lethal weapons was explored, including an enumeration of the types of non-lethal weapons and their areas of application, as well as an identification of some of the challenges that still exist in this domain.

In addition to the literature review and based on it, an original model for the behaviour of an individual in a crowd in the presence of control forces was developed. This conceptual model is an attempt to link together into a coherent structure those variables that were identified by the literature review as significant factors influencing the behaviour of individuals in a crowd. Examples include *personal factors*, such as gender, age, ethnicity and culture, *external factors*, such as environment or weather, and *facilitating factors*, such as the presence of weapons, alcohol and drugs, or the presence of media. A set of seven assumptions is also provided, defining the mechanisms governing the behaviour of individuals in a crowd control situation:

1. The behaviour of an individual in the crowd is influenced by the individual's perception of the behaviour of other crowd members (those that he knows about), as well as his perception of the members of the control forces.

2. Perception of reality (be it control forces actions or other crowd members behaviours) is influenced by personal factors and by external factors.

3. An individual can have several social identities during the course of an event.

4. A shift in social identity may be the result of a rational decision made by the individual taking into account mostly cognitive factors, or it may be the result of an impulsive decision when the individual is so overwhelmed physically or emotionally that these feelings take precedence over everything else (including any cognitive elements).

5. The reinforcement or extinction of a behaviour depends on its perceived consequences, as well as on various facilitating factors.

6. An individual will decide on a course of action (i.e., a behaviour) depending on what he knows (cognitive state), and what he feels physically (physical state) or psychologically (emotional state).

7. Communication (i.e. the act of transmitting information) plays a significant role in the development of the event, including the behaviour of individuals in the crowd.

The model is proposed as a starting point for the future research efforts of the team aiming at building a crowd control modelling and simulation tool. Following some future validation process, the model will be reviewed.

Sommaire

Crowd Confrontation and Non-Lethal Weapons: A literature review and conceptual model

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TM 2007-488; R & D pour la défense Canada – Valcartier; Mars 2008.

En général, la police est davantage concernée par le contrôle des foules que les militaires. Toutefois, il y a eu des situations dans le passé où les forces canadiennes ont eu à intervenir lors d'émeutes durant des opérations de maintien de la paix, par exemple à Drvar en Bosnie, en avril 1998. Les forces canadiennes ont donc besoin de comprendre les comportements des foules et ont besoin de définir les stratégies d'intervention appropriées pour contrôler les foules. Les leçons apprises par le passé sur les émeutes et autres situations de contrôle des foules peuvent être également utiles pour développer des procédures pour gérer les petits et moyens rassemblements de civils qui entourent souvent le personnel militaire et les véhicules durant les opérations.

Ce mémorandum technique est écrit dans le cadre du projet de Fonds d'investissement technologique qui s'intitule : Modélisation et simulation du contrôle des foules. Le but du projet est d'étudier la dynamique des foules en utilisant des simulations numériques et d'évaluer l'effet de l'utilisation des armes non létales dans des situations de contrôle des foules. Le modèle conceptuel sous-jacent aux simulations inclura des facteurs psychologiques et physiques qui affectent le comportement d'une foule et représentera les stratégies et tactiques des forces de contrôle.

Ce mémorandum présente une revue exhaustive de la littérature sur le contrôle des foules impliquant des armes non létales et couvre trois sujets essentiels pour comprendre de tels systèmes. Premièrement, plusieurs aspects liés aux foules, tels que des définitions spécifiques des foules, les phases de développement d'une foule, les aspects psychologiques et une liste des déterminants de la violence des foules, ont été étudiés. Deuxièmement, un sommaire des documents de doctrine sur le contrôle des foules est présenté afin de fournir une meilleure compréhension des objectifs, des modus operandi, de l'équipement et des aspects juridiques qui caractérisent ces missions, et ce, d'un point de vue militaire et policier. Troisièmement, les armes non létales sont étudiées, c.-à-d. qu'une énumération des types d'armes non létales et leurs champs d'application ainsi qu'une identification de certains défis qui existent encore dans ce domaine sont présentés.

De plus, sur la base de la revue de la littérature, un modèle original du comportement d'un individu dans une foule, en présence des forces de contrôle, a été développé. Ce modèle conceptuel est une tentative pour relier dans une structure cohérente les variables qui ont été identifiées dans la revue de la littérature comme des facteurs influençant significativement le comportement des individus dans une foule. Parmi ces facteurs, on inclut les *facteurs personnels*, comme le sexe, l'âge, l'ethnie et la culture, les *facteurs externes*, comme l'environnement ou la température, et les *facteurs facilitants*, comme la présence d'armes, l'alcool et les drogues, ou la présence des médias. Un ensemble de sept hypothèses définissant les mécanismes gouvernant le comportement des individus dans une situation de contrôle des foules est également expliqué.

1. Le comportement d'un individu dans une foule est influencé par la perception que l'individu a du comportement des autres membres de la foule (ceux qu'il connaît) et par la perception qu'il a du comportement des membres des forces de contrôle.

2. La perception de la réalité (que ce soit des actions des forces de contrôle ou des autres comportements des membres de la foule) est influencée par des facteurs personnels et externes.

3. Un individu peut avoir plusieurs identités sociales au cours d'un événement.

4. Un changement d'identité sociale peut être le résultat d'une décision rationnelle prise par un individu tenant compte principalement des facteurs cognitifs, ou peut être le résultat d'une décision impulsive prise au moment où l'individu est tellement submergé physiquement ou émotionnellement que ses sentiments prennent le contrôle sur tout le reste (incluant tous les éléments cognitifs).

5. Le renforcement ou la disparition d'un comportement dépend des conséquences perçues, ainsi que des différents facteurs facilitants.

6. Un individu décidera d'adopter une suite d'actions (c.-à-d. un comportement), dépendamment de ce qu'il sait (état cognitif), et de ce qu'il ressent physiquement (état physique) ou psychologiquement (état émotionnel).

7. La communication (c.-à-d. l'action de transmettre de l'information) joue un rôle significatif dans le développement de l'événement, notamment sur le comportement des individus dans une foule.

Le modèle est proposé comme point de départ pour les efforts futurs de recherche de l'équipe qui visent à bâtir un outil de modélisation et de simulation de contrôle des foules. À la suite du processus de validation, le modèle sera révisé.

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1 Introduction

Crowd control is a function traditionally associated with the police more than the military. However, the Canadian Forces (CF) have had to intervene in riot situations during peacekeeping operations, for example in Drvar, Bosnia, in April 1998 [Coombs, 2006]. The Canadian Forces thus have a need to understand crowd behaviours and to define proper intervention strategies for crowd control. Some lessons learned from riots and other crowd control situations can also be useful to develop procedures to deal with small to moderate gatherings of civilians that often surround military personnel and vehicles during operations.

In Canadian Forces doctrine [DND, 2003a], the procedures related to crowd situations are called Crowd Confrontation Operations (CCO). This expression refers to "military operations conducted by a military force to manage a crowd whose formation, presence or anticipated behaviour is such that action is required". CCO includes crowd management and crowd control. Crowd management are measures that are taken to ease the normal process of a gathering [Berlonghi, 1995; Fruin, 1993]. These measures should normally suffice to ensure the orderly conduct of a crowd. Crowd control refers to all the techniques that are used when a crowd is or will become out of control. These actions are necessary to ensure the safety of people and they include arrests, limited access control, etc. [Berlonghi, 1995] writes "Mostly all problems with crowds can be prevented or quickly resolved when all the aspects of crowd management are well organized. Crowd management is proactive while crowd control is reactive".

This technical memorandum is a literature review on crowds and crowd policing. It is written in the context of the Crowd Control Modelling and Simulation Capability Technology Investment Fund Project. This project aims at studying crowd dynamics with the use of numerical simulations, and at evaluating the impact of the use of non-lethal weapons in crowd control situations. It is intended that the conceptual model underlying the simulations will include psychological and physical factors that affect crowd behaviours, as well as representing control forces strategies and tactics.

This review is composed of four major sections. After this introduction, Section 2 describes the nature of a crowd and the factors influencing crowd violence. Section 3 presents the Canadian Forces doctrine related to crowd confrontation operations, a summary of police doctrines for crowd control and a review of protest policing analysis. Section 4 presents a survey of non-lethal weapons aimed at crowd control situations. Finally, Section 5 presents a conceptual model for crowd behaviour in a demonstration context.

2 Crowd description

This section presents several aspects of crowds. The first part covers a few generalities. Definitions of words relevant to crowds, types of crowds and the usual phases of a demonstration are explained. The second part briefly presents a part of the social sciences and psychological literature pertaining to crowds. Socio-psychological theories of group behaviours, as well as psychological mental state and behaviours important in a crowd context are introduced. Finally, the third part presents ten elements that influence violent behaviours in a crowd environment.

2.1 Generalities

In order to understand how crowds can be modelled and simulated, it is important to first understand the nature of crowds as well as the different terminologies used in the literature to describe or differentiate crowds from other types of human gatherings.

2.1.1 Definitions

Different words are used in the context of crowds to define the crowd itself and to characterize its activities. These words often characterize the degree of violence of the crowd as well as the lawfulness of the gathering. The following paragraphs define the terms crowd, gathering, demonstration, riot and mob as they are used in literature pertinent to the police and military domain.

Crowd - According to [DND, 2003a], "a crowd is defined as a concentration of people whose present or anticipated behaviour is such that it requires action for the maintenance of order". A crowd that meets according to local laws and moves with no hostile intent is not illegal. However, such a crowd has the potential to commit criminal acts or to impact on CF operations. [Sime, 1999] is more general and defines a crowd as "any relatively large number of occupants gathered in a setting at a particular point in time". In this study, the term crowd is used following this latter definition.

Gathering - The Army Doctrine report [DND, 2003a] defines a gathering as "a group of people in a recognized area". Synonyms for gathering are assembly and meeting.

Demonstration - A demonstration is defined in [DND, 2003a] "as a crowd that is exhibiting sympathy for or against authority, or some political, economical, or social condition. They may be legally sanctioned or illegal, but the process of expression often has statutory and constitutional protections. Mass demonstrations constitute the assembly of large crowds at a particular place and time for a common purpose". Similarly, in [OPD, 2004], demonstration is used generically in this policy to include "a wide range of First Amendment activities which require, or which may require, police traffic control, crowd management, crowd control, crowd dispersal or enforcement actions in a crowd situation". Thus, the term "demonstration" as used within this policy includes, but is not limited to, marches, protests, student walk-outs, assemblies and sit-ins. Such events and activities usually attract a crowd, including participants, onlookers, observers, media and other persons who may disagree with the point of view of the activity.

Riot - A riot is defined in [Lebeuf and Soulli□re, 1996] as □an unlawful assembly that has begun to disturb the peace. A crowd can quickly lose control and develop into a riot that may involve some members of the crowd committing violence/crimes□. The Merriam-Webster dictionary defines a riot as □a violent public disorder; specifically, a tumultuous disturbance of the public peace by three or more persons assembled together and acting with a common intent□[Merriam-Webster].

Mob - A mob is defined in the Merriam-Webster dictionary as □large or disorderly crowd; especially**:** one bent on riotous or destructive action□[Merriam-Webster].

2.1.2 Canadian Forces classifications of crowds

The CF doctrine [DND, 2003a] classifies crowds into seven different categories. The first five types are considered orderly, as these crowds are largely self-controlled. Individuals in these crowds mostly act rationally. The crowd often does not have a well defined organisation and the crowd leaders prefer to keep peace. The last two types of crowds are disorderly. These crowds are often very emotional, sometimes aggressive, and their behaviour is unpredictable. These crowds could quickly cause a riot. Militant members in these crowds are easily identifiable, and spectators are often present. The following paragraphs give a few characteristics of the seven types of crowds.

Casual - A self-controlled crowd without leaders and in which the individuals act independently. The crowd lacks structure and can easily be controlled by authorities (e. g. shoppers).

Cohesive - A crowd in which people act individually but are unified for a specific moment (the event). The crowd lacks structure, and respond well to firm requests from the authorities (e. g. soccer fans).

Expressive - A crowd in which participants have a common purpose, and in which a leader can often be identified. Some of these crowds have a certain structure and the crowd behaviour is often emotional, but usually not aggressive (e. g. political rallies).

Demonstrative - A crowd in which people agree on a position and have a common purpose. People act individually and rationally and some leaders are identifiable. The crowd is usually emotional, but disciplined and non-violent. Also, these crowds have often statutory and constitutional protections (e. g. strikes, social action rallies).

Aggressive - A very emotional crowd where people act individually or in groups, and in which leaders are often identifiable. There is a possibility that the crowd become violent, and disorderly.

Acquisitive - A crowd in which some individuals conduct vandalism and random looting. Often an otherwise orderly demonstration is used for cover for these activities.

Panicked - A crowd which lacks organisation, purpose and control. People often exhibit uncontrolled and violent behaviours. Causes of panic include the presence of a perceived threat, a situation of entrapment, a natural disaster, the employment of weapons of mass, etc. It may also be caused by the authorities when they attempt to disperse a crowd.

2.1.3 Phases of crowds

The dynamics of crowds can be analyzed within two different timeframes. The first timeframe is that of the demonstration itself. The second timeframe is longer as it also includes events prior to and after the demonstration.

Within the first timeframe, [Kenny *et al.*, 2001b; Piland and McKenzie, 2006] identify three phases to crowd behaviour. These phases are the assembling (also called gathering or convergence), gathering (also called rallying, or task) and dispersal phase (also called divergence). [Gaskins *et al.*, 2004] indicates that the level of violence of a crowd varies according to the phase of the crowd development.

The doctrine report [DND, 2003a] considers riots within the second longer timeframe. It divides the timeframe in four phases, the pre-mobilization, mobilization, outburst and post-hostility phases.

- The pre-mobilization phase corresponds to the period of time (days, months or years) during which beliefs in opposition to the established order develop. Dissident groups and militant leaders often emerge during this period of time.
- The mobilization phase is the time period (hours or days) during which the crowd forms. It often follows a precipitating event or incident.
- The outburst phase is the time period (hours or days) during which groups or individuals commit serious breaches against the peace. Violence is the main characteristic of this phase.
- The post-hostility phase begins when the control forces end the collective violence. Short term measures are taken by the control forces to maintain law and order, and long term measures are taken by the civilian authorities to lessen the conditions that led to the unrest.

2.2 Crowd psychological aspects

There is a wide recognition within the simulation community of the need to integrate more psychological components in simulations of human behaviours. Different approaches are used by researchers for that purpose. Unfortunately, all these approaches present difficulties. Indeed, the domain of psychology and social sciences is sometimes confusing, and researchers in these fields do not agree on the different phenomena that happen within a crowd. Furthermore, the crowd psychological characteristics that need to be incorporated within a model or simulation depend significantly on the objectives and the environment of the simulation that is developed. For instance, crowd simulations may focus on pedestrian flows, emergency situations, sports and demonstrations turning into riots or, in the present case, crowd control in a military context. Moreover, as noted in [Kaminka and Fridman, 2006], “in social sciences and psychology, models often offer only qualitative description, and do not easily permit algorithmic replication. In computer science, models are often simplistic, and typically not tied to specific cognitive science theories or data.”

This section provides a brief overview of some sociological and psychological characteristics that should be considered in order to develop realistic models of crowd behaviours in demonstrations and riots. Section 2.2.1 presents some theories that explain collective behaviours in the context of

crowds. Section 2.2.2 presents psychological mental states relevant to crowd situations and Section 2.2.3 presents the behaviours observed in these circumstances. Behaviours are essentially externalisation by crowd members of their mental state. A note needs to be made that, as the interest of this research focuses on the behaviours of violence exhibited during demonstrations, the definition of violence used in this article mostly relates to the physical acts of violence and does not integrate the concept of psychological violence.

2.2.1 Socio-psychological theories of crowd behaviours

Several socio-psychological theories have been proposed to explain the dynamics of crowds, or the crowd behaviours. The underlying assumption that unifies all these theories is that a crowd is not simply the sum of the individuals who compose it. This is basically an acknowledgement that the interactions between the individuals in a crowd can make the outcomes of crowd actions significantly different from the outcomes of actions by the same number of individuals not interacting with each other. The various theories that have been developed are all attempts to understand and explain *why* this is happening, which proved to be a very difficult matter, due to the variance in the types of crowds, the types of outcomes, and the initial conditions. As such, any one theory is usually able to explain a certain number of crowd phenomena, but not others. Collectively, however, they are able to explain most observed crowd phenomena. This observation stands at the basis of the conceptual model proposed in Section 5, which will not be based on a single theory, but will borrow elements from several of them. For now though, only a brief review of some of the well known theories will be provided.

One of the oldest theories of crowd psychology was proposed by Le Bon in 1895 [Le Bon, 1905]. One of the salient points of his theory is that members of a crowd tend to lose their individuality to make way for a collective mind. He describes the crowd as being always intellectually inferior to an isolated individual (an irrational crowd), while from the point of view of feelings and actions it can be either superior (an heroic crowd) or inferior (a criminal crowd), depending on the suggestions to which the crowd is subjected. He describes the crowds as being impulsive, influenced by contagion and inherently susceptible to suggestions from a leader to which they instinctively obey. Le Bon also comments on the importance of crowd leaders and the means they use to manipulate the crowd: affirmation, repetition, use of simple messages and images. He talks about the sense of anonymity and loss of responsibility that is experienced by the members of the crowd. Some of Le Bon's ideas, a product of their time - a period of significant social unrest in France during the 1890's - have received their share of criticism, often due to the fact that they do not explain certain crowd phenomena as observed one century later. However, many of his observations did stand the test of time and are still acknowledged today in a formal manner by scientists, and informally by regular citizens that have been exposed to events involving crowds.

An individualistic approach to crowd behaviour, sometimes referred to as the convergence theory, is championed by Allport [Allport, 1924]. According to this theory, individuals in a crowd will act just as they would normally do (i.e., without their belonging to the crowd influencing their actions in any way), crowd behaviour being different from individual behaviour just by some multiplicative factor. The reason why many people within a crowd behave similarly (explained by Le Bon through contagion) is in Allport's opinion the fact that crowds are the result of a natural convergence of like-minded individuals with similar interests. In other words, it is not the crowd that causes people to behave in a certain way, but rather people who behave similarly gather together to form a crowd. A by-product of this theory is an implicit acknowledgement that crowd

behaviour is not irrational (i.e., unpredictable), but rather the rational consequence of widespread convictions shared by the crowd members (i.e., predictable to a significant extent).

The emergent-norm theory has been proposed by Turner and Killian [Turner and Killian, 1972] to explain crowd dynamics. In their view, crowd behaviour is neither as unpredictable (irrational) as Le Bon's theory suggests, nor as predictable as convergence theory implies. Their theory acknowledges that similarity between people may draw them together, but also that interactions between crowd members are important. In other words, crowd behaviour has a predictable component given by the known individual behaviours of the crowd members, as well as an unpredictable component given by new behaviours that are born through the interactions occurring among the crowd members. A nuance introduced by this theory is that the interactions between individuals do not lead to some irrational behaviour, but rather to new "norms" that are valid (i.e., accepted by the crowd) for the period of existence of the crowd. For example, an unusual action by a crowd member that is sanctioned by the crowd with some signs of acceptance (e.g. the action is being imitated by other people) may become a new norm of behaviour. As time passes, the new norm may actually be enforced by some members whom would pressure other individuals to conform.

The social identity theory is one of the social psychology theories dealing with the self, aiming to explain the concept of identity. The theory supports a direct link between one's identity and one's behaviour, a link that was used to explore areas such as inter-group phenomena (e.g. in-group bias or inter-group conflict), or crowd behaviour, including crowd violence. The concept of *social identity* initially described in [Tajfel and Turner, 1986] is a cognitive process where individuals internally acknowledge that they belong to a number of different social groups[1]. In this document, Tajfel suggested that the feeling of belonging to a group can make a person behave according to the norms of the group. He stressed the uniformity of perception and action among the members of a social group, supporting the concept of *depersonalization* of the individual when he thinks of himself as a group member. On the other hand, Turner expanded on the social identity theory through his self-categorization theory that brings together the concept of personal identity[2] and that of social identity[3]. According to this theory, depending on the situation, an individual may shift from a personal to a social identity or from one social identity to another, since the theory also acknowledges the fact that an individual may have several social identities. To increase the practical value of this theory, it is essential to be able to determine when and why such shifts occur. The social comparison theory proposed by Festinger [Festinger, 1954] has been used for this purpose. The basic idea is that part of a normal psychological functioning is that a person needs to have a positive image of oneself, and such an image can be obtained through comparison with similar others. The natural tendency is to look for those comparisons that will reflect positively on the person, allowing for an increase in self-esteem. This translates, for example, into a desire to belong to a prestigious group, or to the group that wins, and so on. The need to increase one's self esteem is deemed to be the reason that shifts from the personal identity to a social identity or between different social identities occur.

[1] A social group is a set of individuals who hold a common social identification or view themselves as members of the same social category.
[2] Personal identity is the result of thinking of the self as a unique individual.
[3] Social identity is the result of thinking of the self as a member of a group.

In recent years, most developments in the area of crowd research were based on the social identity theory – variations, ramifications or extensions of this theory. Examples of research work in this domain include [Reicher *et al.*, 2004] who seems to consider that individuals can easily shift from one group identity to another. On the other hand, [Vider, 2004], based on [Turner and Killian, 1972], is rather inclined to consider that an individual enters a difficult process of compromise when there is a conflict of social identity, and this results most of the time in a new balanced set of behaviours that satisfies the individual. In the same realm, [Stott *et al.*, 2001] uses the Elaborated Social Identity Model (ESIM) of crowd behaviour [Drury and Reicher, 2000] to explain the presence of crowd disorders during events.

2.2.2 Psychological mental states

During a demonstration, the psychological state of an individual within the crowd varies depending on the events and on his perception of the behaviour of nearby entities (control forces and other members of the crowd). [Kenny *et al.*, 2001b] considers five psychological factors essential to the understanding and assessment of individual behaviours in crowd situations. These psychological factors are motivation, confidence, stress, focus and emotions. Each of these psychological factors has some influence on the behaviour, but emotions have the most direct influence on the behaviour. They guide decisions, influence reactions to situations and determine how individuals feel. [Kenny *et al.*, 2001b] asserts that emotions vary among individuals in a crowd and change rapidly depending on the perceived threats (e. g. the size and actions of opposing forces).

In this section, we emphasize emotions and discuss the following emotional mental states: frustration, emotional excitement, fear, panic and hostility. Motivation and stress are also discussed since they could impact the crowd behaviour.

Frustration - Frustration is a mental state that appears when an individual is prevented from accomplishing a goal or fulfilling a desire. [Lachman, 1996] specifies that frustration appears when an "obstacle is encountered between a motivated individual and the goal of that person". [Lachman, 1996] identifies aggression towards the perceived source of frustration as a primitive reaction to frustration. [Lachman, 1996] specifies that each person develops a tolerance for frustration and that undesirable reactions to frustration are likely to occur when this tolerance is exceeded.

Emotional excitement - [Lachman, 1996] specifies that emotional excitement is an emotional state that the crowd member (or rioter) could have. This emotional arousal may precede or accompany the triggering incident of riot behaviours. Excitement could be the result of anger, fear, rage or hate. Also, in some circumstances such as celebrations, excitement appears as a result of joy and having fun, and this excitement can also lead to serious riot [Vider, 2004].

Fear - [Artwohl and Christensen, 1997; Grossman, 1995] identify fear as an emotional state with physical, perceptual and behavioural effects. [Reece, 2002] specifies that fear reduces the interest toward performing "mission" tasks and satisfying curiosity, but increases the desire to perform self-preservation tasks.

Panic - [DND, 2003a] defines panic as "extreme fear that inspires unreasoned and worried efforts to reach safety. It is highly contagious and can cause people to become so irrational that their

actions endanger themselves and others. This psychological mental state arises when the crowd perceives a threat (real or imaginary) and tries to escape. It could also arise in case of entrapment or jostling.

Hostility - [Reece, 2002] introduces hostility as a mental state that can vary during a demonstration. High levels of hostility encourage confrontations with antagonists.

Motivation - [Kenny *et al.*, 2001b] defines motivation as the individual's ability to be committed to the crowd's cause despite fear, fatigue, opposition and personal needs. [Reece, 2002] considers that motivation encourages performing mission tasks and taking actions to confront antagonists.

Stress - [Kenny *et al.*, 2001b] defines stress as physical, mental or emotional reactions to internal or external demands. For example, stress may be caused by the presence of police or by individual needs (food, sleep) and has an impact on the individual's motivation to pursue his goals.

2.2.3 Behaviours

Numerous behaviours can be observed within a crowd. Two aspects will be discussed in this section, the presence of collective behaviours and the occurrence of violent behaviours.

[McPhail and Wohlstein, 1983] discusses collective behaviours in the context of gatherings, demonstrations and riots. This article remarks that collective behaviours in which a majority of the individuals in a gathering participate are rare, simple and short-lived. Actions performed by small clusters of individuals are much more frequent. Some examples of simple collective behaviours are collective pedestrian movements, a convergent direction of focus of the crowd or collective vocalizations (chanting, cheering, laughing ...). It is important to note that crowds are far from being unanimous entities and that some individual behaviours matter.

Riots are not really different in this regard. Relatively few behaviours are performed by large clusters of people. Also only a small proportion of the behaviours that occur are violent [McPhail and Wohlstein, 1983; Gaskins et al., 2004], but, as pointed out in [Gaskins et al., 2004], these violent activities have often a large impact on the development of the gathering. Most other behaviours are routine.

[Lachman, 1993] lists several violent behaviours that are observed in riot situations. They include "the throwing of stones, rocks and bricks, smashing windows, setting fires, beating, stabbing, shooting and otherwise assaulting people, attacking and overturning vehicles, furniture or articles of commerce, vandalizing homes and commercial establishments, robbing and stealing, resisting agents attempting to enforce peace and order, and ignoring official and unofficial authority". [Nguyen et al., 2005] categorizes the crowd behaviours into six categories depending on the aggression level. These categories are:

1. Neutral: e.g. wandering

2. Avoidance: e.g. fleeing, hiding

3. Curious non aggressive posture: e.g. hanging out/watching, standing on elevated structures, chanting, flag waving.

4. Aggressive posture: e.g. burning tires, building a barricade, taunting/yelling, carrying sticks, rising firearms.

5. Aggressive non-lethal actions: e.g. throwing rocks and projectiles, pushing/shoving, hand to hand fighting, and dragging bodies through streets.

6. Violent lethal actions: e.g. shooting, throwing Molotov cocktails, driving civilian vehicles with mounted machine-guns.

2.3 Determinants of crowd violence

In the previous section, we discussed two psychological aspects (social identity and psychological mental states) that have an impact on the behaviours of the crowd. It is concluded from this brief psychological overview that the emotional state of the individual as well as his social identity have an impact on the behaviour of the individual in the crowd and on the emergence of crowd violence. But, these psychological factors are not the only determinants of crowd violence. The aim of this section is to explore and explain other factors that influence crowd violence. Understanding the factors that influence crowd behaviours may allow for better policing and may help to avoid lethal outcomes.

The different aspects that influence crowd violence are grouped in the following ten categories:

1. Demographical aspects

2. Crowd composition and objectives

3. Crowd size and density

4. Culture

5. Alcohol, drugs, noise and music

6. Crowd equipment

7. Media

8. Physical environment

9. Individuals and groups actions

10. Control forces actions

The first six sections describe characteristics of the crowd itself. The seventh section describes the role of the media, while the eighth section discusses the effect of the physical environment (space,

time and weather). The last two sections refer more to the dynamic of the demonstration and are concerned with the effects of the actions of the different actors on the demonstration.

2.3.1 Demographical aspects

Male/Female Gender - According to many authors [Siann, 1985; Gaskins *et al.*, 2004; Madensen and Eck, 2006], the ratio of male to female individuals within the crowd influences the level of violence. [Siann, 1985] mentions that "some research indicates that crowding results in higher levels of aggression in males than it does in females, although the reasons for this are unclear". Similarly, [Madensen and Eck, 2006] writes that students committing acts of violence and vandalism at university student gatherings are more likely male than female.

Age - Age is also a characteristic that affects the propensity of individuals to violence. For instance, "teenage years are frequently associated with omnipotence and higher risk taking" [APA, 1993; Pikunas, 1976; Vogelman, 1990]. The Canadian doctrine report [DND, 2003a] identifies crowds composed of gangs of youths or military-age persons as particularly prone to violence.

Socio-economic status - The statistical study of [DiPasquale and Glaeser, 1998] suggests some factors that help explain the Los Angeles riot of 1992. The authors of the study found that the high unemployment rates of young black men in that area could influence violent behaviour and they associated urbanization and rioting. They also conclude that when time or property costs of rioting are high (that is, when people have more wealth), people are less willing to riot. [Kaplowitz and Campo, 2004] also finds that people with lower class standing are more likely to riot. Also, [McPhail and Wohlstein, 1983] identifies a relationship between crowd violence and the socio-economic status of crowd members. Similarly, many other authors suggested that poverty and social injustices of all sorts are related to the eruption of violence during demonstrations [Gaskins *et al.*, 2004; Mustonen *et al.*, 1996; Pate, 1994; Pene, 1994; Ward, 1994; Tilly, 1986; Keith, 1989].

However, some of the preceding conclusions are contested. For example, [DiPasquale and Glaeser, 1998] finds that poverty at the community level is not a major determinant of violence. Also, [Kenny *et al.*, 2001b] finds "individuals that were politically and/or economically deprived were not more likely to aggress to reduce the frustration resulting from their deprivation".

Ethnic diversity - The statistical study of [DiPasquale and Glaeser, 1998] suggests that ethnic diversity may be another factor. As they observe, Miami and Los Angeles had the two biggest riots of the past 15 years in the United States and are also the most ethnically diverse cities. The effect of ethnic diversity on crowd violence may be linked to racism which has been often related to the eruption of violence during demonstrations [Pate, 1994; Pene, 1994; Ward, 1994; Tilly, 1986; Keith, 1989]. Along similar lines, ethnic exclusion may be a factor as well. As an example, in France, violence has been identified as a likely outcome of gatherings that are exclusively composed of foreigners with underprivileged status [Favre, 1990].

2.3.2 Crowd composition and objectives

Understanding the crowd composition and its sub-groups objectives is essential to evaluate its tendency to violent behaviours. This implies comprehending the overall objectives pursued by the crowd as much as the objectives specific to one of its sub-groups. For instance, demonstrations denouncing violence, have less potential for the emergence of aggressive behaviours. The potential for a riot often appears when a number of people are participating in a demonstration due to empathy with a real or perceived injustice for which the responsibility can be assigned and from which one can expect that a significant part of the community or organisation will participate. Moreover, these participants must be convinced and be able to make people believe that the actual system in place will not resolve the injustice [DND, 2003a].

Also in some demonstrations, a few groups are well known for carrying an objective of intended violence. This notion refers to groups of individuals who do not carry the principles, values and goals of the demonstration, but rather act to make their perceptions of the situation match their goal of violence, by participating in vandalism, looting, arson, and assault [McPhail, 1994]. As explained in [Buettner, 2004], a crowd composed of participants who, from the beginning, have the objective of vandalizing and burning property are examples of individuals controlling their perceptions for a different goal that of creating destruction and violence. Similarly, [Gaskins *et al.*, 2004] refers to these individuals as instigators within a crowd. In that research, the presence of instigators within a crowd is identified as the most significant variable linked to crowd violence. In these cases, these groups of individuals will interpret any action taking place during the demonstration as an occasion for violence.

This question of crowd composition and objectives is directly tied to the concepts of cohesion and motivation of the participants. Following [Filleule, 1993; Gaskins *et al.*, 2004], the heterogeneity of the demonstrators, for example the configuration of the group and the differences between demonstrators, is likely to increase the risk of degeneration. Crowd cohesiveness and motivation refer to the degree of commitment to the cause [Gaskins *et al.*, 2004] or goal pursued by the participants. Besides the similarity of the objectives of the different groups participating in a demonstration, there is also a requirement to evaluate the level of diversity between the groups. In fact, while two groups may carry the same objective, their characteristics, values and principles can be very different, and consequently the socially accepted behaviours to express their views will also be different.

The crowd objectives should not necessarily be seen through a social and political lens. Several riots can be understood as apolitical rampages, whose participants, typically young males, are motivated by a search for excitement and the thrill of seeing that they can make things happen [Banfield, 1968; Bolce, 1982]. Celebrations are one of the reasons for crowd formation, and in this case, it is probably the sense of power born from belonging to the crowd that, at some point, becomes an end in itself and leads to violent behaviours.

Finally, the experience of participants in demonstrations and riots seems a relevant parameter to predict crowd violence [Gaskins *et al.*, 2004; Filieule, 1993; Favre, 1990]. [Favre, 1990] finds that the less experienced a crowd is with group demonstrations, the higher the chances are that a riot might develop. Nevertheless, [Favre, 1990] also observes that when a group is involved in consecutive demonstrations during a short period of time, there is more likelihood for disorder.

2.3.3 Crowd size and density

[DND, 2003a] mentions that the size of a crowd is an indicator of violence (more specifically, the presence of groups of more than 50 people or the uncontrollable increase of crowd size). Overcrowding could have a detrimental effect on social behaviour. [Gaskins *et al.*, 2004] identifies crowd size as a variable influencing violence in a crowd. [Favre, 1990] mentions that the higher the number of participants in a gathering, the higher the chances for degeneration. Along the same line of thinking, [Vogelman, 1995] observes that "overcrowding tends to reinforce existing feelings and emotions, and that the extent of this effect is dependent on a number of variables, such as: duration of exposure; amount of activity required; the formality and informality of the situation; the expectations of the individual [Freedman, 1972]; and the sex of the subjects [Siann, 1985]". Likewise, the possible anonymity of the violent participants [Filieule, 1993], and the fact that, in the case of large crowds, a group's leaders have more difficulty preventing participants from becoming violent [Waddington *et al.*, 1987a; Waddington, 1987b] are all conducive to violent behaviour.

2.3.4 Culture

Culture is defined by [Boas, 1911] as "the system of shared beliefs, values, customs, behaviours, and artefacts that the members of society use to cope with their world and with one another, and that are transmitted from generation to generation through learning". The concept of culture is important for the understanding of violence in crowds. In fact, violence has a relatively strong cultural component as some societies consider it more acceptable than others. As discussed in [Vogelmann, 1995], the acceptability of violence is learnt through socialization, and several cultural elements suggest that society tolerates or even prizes violence, i.e. that one can gain advantages by using violence. Within a group that endorses violent behaviours, [Vogelman, 1995] states that the perpetration of these behaviours "confirms the individual's commitment to the group's norms and validates his membership of the group". It can also facilitate group bonding.

For instance, some specific cultural factors of the Iraqi people, that could have an impact on violence, are included in the observations of [Gaskins *et al.*, 2004]. The latter identifies the Iraqi culture with some elements such as the strength of the need for revenge or the willingness to take risk and the societal acceptance of violence. This emphasizes the importance of being knowledgeable with the demonstrator's culture through the importance of "the familiarity with enemy" [Gaskins *et al.*, 2004]. [Goldstone and Janssen, 2005] also considers culture as a key element for crowd modelling and elaborates a model that deals with the division of a culture into sub-cultures.

Another cultural element that might cause violent behaviours in a crowd is the history of the crowd or the so called collective memory of a group. Indeed, [Reicher *et al.*, 2004] believes that "elements of the history might impact our stereotypes and incline the crowd to act with violence or not toward another group". Similarly, [Buettner, 2004] and [Vider, 2004] also consider that memory plays a role, but more or less like a ritual or a tradition specifically based on riotous behaviours. Finally, a specific location may itself carry a history of previous demonstrations turning into riots as [Vider, 2004] remarks in the case of the 1999 Woodstock riot.

2.3.5 Alcohol, drugs, noise and music

[Vogelmann, 1995; Gaskins *et al.*, 2004] identify alcohol and drugs consumption by crowd members as a cause of crowd violence. The consumption of alcohol and drugs can have a significant influence on the propensity of individuals to violence because it lowers the normal inhibition to the use of violence that individuals acquire through socialization. It also increases the risk taking of individuals. [Kaplowitz and Campo, 2004; Frosdick and Marsh, 2005] observe that restrictions on the availability of alcohol are probably not a good solution. In some cases, these restrictions could even exacerbate the problem as there might be compensatory drinking at higher levels before and after the restrictions are applied.

Noise is another external element that can have a large influence on the psychological states of individuals. [Broadbent, 1979] finds that "noise increases the general state of arousal or excitement of the nervous system". The survey of the literature of [Cornwell *et al.*, 2002] supports this conclusion. However, an increase in noise does not necessarily lead to an increase in aggressive behaviour, but according to informal observations and studies, it seems that people are more irritable and less self-controlled after noise exposure [Stevens *et al.*, 1941].

Music is another factor that can influence the psychological state of individuals. [Apter, 1992] and [Gowensmith and Bloom, 1997] respectively assume that rock music and heavy metal music, like drugs and alcohol generally increase arousal. However, the degree to which music increases arousal depends on the kind of music. On this topic, [Arnett 1991; Kortaba and Wells, 1987] assert that heavy metal music fans are in general angrier, more agitated, and more aroused than other people. These studies still suggest that crowds in events in which loud rock or heavy metal music are played could be or become prone to violence.

2.3.6 Crowd equipment

The presence of weapons and equipment for protection has been reported as indicators of crowd violence [Gaskins *et al.*, 2004; DND, 2003a]. Also, firearms can be used very efficiently by instigators to provoke reactions from the security forces. "Gunmen within the crowd or in the surrounding buildings and side streets may aim not only to cause casualties, but also to provoke the security forces into firing at the crowd" [DND, 2003a].

Another type of equipment that has an influence on the evolution of demonstrations is communication equipment. Communication technologies are used by demonstration leaders to either organize the demonstration or to communicate information during the demonstration. [Rheingold, 2002] for example observes that wide availability of mobile telephones and wireless networks help people organise collective actions more effectively and allow demonstrators to cooperate in ways not possible before. Similarly, [Lachance, 2003] explains that the Internet is a very useful communication tool for organizers. They can create websites and mailing lists and diffuse information faster and with only a few resources. For example, the coordination of activities, ideas, tactics and strategies can all be exchanged on the Internet. During the Summit of the Americas in 2001, it was possible to find on the Internet half a dozen protest guides with information on the geography, the history, the security measures and past activism in Quebec City. By providing all this information, the activists were better prepared to face control forces. They could be aware of means of escape; they could easily find accommodation, etc. So, technology enables the circulation of messages faster and more efficiently.

2.3.7 Media

[Gaskins *et al.*, 2004] establishes a relationship between the presence of media and crowd violence. According to [Lachance, 2003], the media play a relevant role as activists measure the efficiency of their actions through the impact of these actions in the media. Similarly, [Vider, 2004] observes that the media play a role in the "ritualizing" of memory. Furthermore, [Frosdick and Marsh, 2005] reports that media coverage (sensationalism and anticipation of violence during certain matches) on football disorder is extensive. These studies all agree that the media have an influence on the behaviours during an event.

[DND, 2003a; Meyers 2000] mention that the advance media promotion of a demonstration often increases the risk of violence. [Meyers, 2000] considers that riots can happen as a series of interdependent events where mass media plays a key role by "creating and sustaining collective violence and protest waves". Finally, [Lachance, 2003] notes that media reports prior to an event of possibilities of violence can create a climate favourable to violence by alienating the protesters from the rest of the population.

2.3.8 Physical environment

Three elements are regrouped within the physical environment: the geographical surrounding of the demonstration, the time of the day and finally the weather.

The location of a demonstration has a significant impact on a demonstration. For example, whether the demonstration happens in a big city or in rural area will influence the size of the demonstration [DND, 2003]. Also, [Vogelman, 1995] mentions that the "perceptions of the safety of the venue may be influenced by the degree to which the venue is concealed from public view and the way in which the structure of the venue makes it easier or more difficult for those wanting to prevent violence to succeed in doing so." For instance, the particular topography of Quebec City and its geographical position in Canada influenced the protest during the Summit of the Americas in 2001 [Lachance, 2003]. Also, the cliff separating the city served as a natural fence in the restricted area. These studies associated the geographical position and geography where the riot took place with the protests. Similarly, the empirical results of the study of [DiPasquale and Glaeser, 1998] suggest that the sheer size of Los Angeles had a negative influence during the Los Angeles Riots in 1992.

The time of the day has also an influence on riots. [Kenny *et al.*, 2001b] reports that riot intensity decreases when it is normally time for personal activities such as working, eating and sleeping. Besides, in the majority of cases, riots begin after working hours and on weekends.

Finally, it is not surprising that the temperature could influence uprisings. For example, a study of the riots in the 1960s in the United States reveals that the frequency of riots peaked at about 27°C, well above the average temperature in the United States [Baron and Ransberger, 1978]. [Berkowitz, 1972] associated heightened temperatures with violence: irritability and arousal would increase with the temperature. People are less likely to gather in cold weather.

2.3.9 Individuals and groups behaviour

[Reicher *et al.*, 2004; Stott *et al.*, 2001] note that even if a group holds to values of non violence, if the actions of other groups (resp. control forces) are perceived as legitimate (resp. illegitimate) use of violence, a social identity shift may lead the members of the first group to the acceptance of some violent behaviours. Therefore, acts of violence might occur if the actions of control forces are considered illegitimate or the violent actions of another group of demonstrators are perceived as legitimate. In addition, it has also been recognized by the same authors that some acts of illegitimate violence that are performed by group members can be suppressed by other members of the same group if these behaviours do not correspond to a set of accepted behaviours.

[Vider, 2004] considers the impact of the behaviour of group leaders on the behaviour of the other individuals forming a crowd. Some leaders may, for example, encourage collective disorder as a form of protest. [Reicher *et al.*, 2004] prefers emphasizing the prototypical behaviour of any individual rather than solely the behaviours of the leaders. These prototypical behaviours are then taken as an exemplar and imitated by other crowd members. This may explain how agitators are able to push the crowd toward civil disorder or disturbance. Examples of agitators techniques include propaganda, inflammatory speeches, exploitation of a hate figure, successful violence, and rumours. Rumours often spread with significant speed in a crowd while the message might get largely distorted. As a rumour spreads, many people will speak and act as if the rumour was true.

2.3.10 Control forces actions

The behaviour of the control forces has a large influence on the unfolding of a gathering. This section discusses control forces actions that are conducive to crowd violence. As noted in [Waddington, 1987b], the main factor is the perception of legitimacy of the control forces actions by the crowd. Violence often occurs if the participants in a gathering feel that the control forces are attempting to stifle a legitimate protest, and that the police are partisan defenders of an unjust system with whom the protesters need not feel obliged to comply [Waddington, 1987b]. Likewise, a wrong reaction or technical mistake from the law enforcement may be seen as repressive, and may increase the chances of civil disorder [Lebeuf and Soullière, 1996; Monjardet, 1992; Chatterton, 1987].

[Jefferson, 1992] explains that police culture coupled with the impression projected by the law enforcement services on the population is in itself a disorder factor. The presence of militarized police officers with visors, shields and in full battle dress, morally prepared and physically ready for the worst can provoke crowd resistance and degenerate into violence. Furthermore, depending on the situation, the appearance of control forces may have different effects. For instance, [DND, 2003a] observes that the deployment of control forces could have a calming effect when the protest is local and minor, and particularly if it happens before violence really emerges. In other cases when the level of disturbance is already high and widespread, it may be preferable for the control forces to move in discretely.

Also, a confrontation may arise between part of the crowd and the security service of a demonstration if a previous agreement between the organizers and the control forces is broken [Berlioz, 1994; Filieule, 1993; Waddington *et al.*, 1987a]. Finally, the hostility of the control forces toward demonstrators [Favre, 1990] and a lack of flexibility in the application of the police

doctrine [Waddington *et al.*, 1987a; Waddington, 1987b] increase the risk of degeneration. However, [DiPasquale and Glaeser, 1998] found that an increase in the probability of arrest diminishes the probability and size of riots. Section 3 discusses in more detail the control forces. It covers the main elements of military and police doctrines that were in part designed to avoid the pitfalls mentioned in this section.

3 Control forces doctrine

This section presents a summary of the military and the police doctrines in crowd control situations and reviews the literature covering the analysis of protest policing.

3.1 Military doctrine

Before 1998, the Canadian Forces (CF) were prohibited from any training for riot and crowd control. However, as a result of crowd confrontation incidents involving the CF in the Drvar riots of 1998, a capability gap in the field of crowd confrontation was identified. Consequently, a doctrine for crowd confrontation operations [DND, 2003a] was authorized "for the purposes of force protection or mission accomplishment during operations, and to permit the training and equipping of CF units".

As commanders and soldiers were provided with the capability to deal with crowds interfering with operations, a new term *Crowd Confrontation Operations* (CCO) was coined to describe the CF activities in this role. This terminology differentiates the military role from crowd control or riot control that has traditionally been considered police functions. CCO is defined as "military operations conducted by a military force to manage a crowd whose formation, presence or anticipated behaviour is such that action is required" [DND, 2003a]. This section gives an overview of the military doctrine described in [DND, 2003a].

3.1.1 Objectives

The CF objective, defined in [DND, 2003a], is to "train and equip the personnel in order to successfully achieve mission success and disengage from crowd confrontation situations without having to resort solely to the use of deadly force". A manoeuvrist approach is applied to CCO. It is defined in [DND, 2003a] as an approach that seeks "to defeat the enemy by attacking his psychological and physical cohesion, his ability to fight as an effective coordinated whole, rather than destroying him by incremental attrition". [DND, 2003a] specifies that force should not be used when the assigned duties can be achieved without it. Even when force is allowed, it must be limited to the minimum and must be intended to achieve the desired result with minimum injury to persons and property. Inappropriate use of force may prevent the accomplishment of the mission and could have serious legal implications. However, the CF may face obstructionist behaviours from crowd participants (agitators). In such circumstances, they have to remain calm and professional, and have to avoid overreacting.

3.1.2 Conduct of crowd confrontation operations

The planning of CCO

The need for a military response to crowd confrontation situations may sometimes be predicted or it may arise suddenly. In the former case, the response is pre-planned including the approach, the force deployment, the tactics and the use of weapons. In the latter case, an emergency response

can be achieved by carrying out the force deployment and the related tactical decisions without any pre-planning.

For predicted events, the CF should establish a general (long-term) plan as well as develop a more specific preparation. The long-term preparation would include guidance for CCO for a particular operation, specific rules of engagement (RoE), training, and acquisition, provision and storage of equipment that may be required. The more specific preparation, reported from [DND, 2003a], consists of:

1. Collecting relevant information for the plan development;

2. Coordinating with local authorities, local police, and, when applicable, with other agencies such as the International Police Task Force (IPTF), the United Nations High Commissioner for Refugees (UNHCR) and Non-Governmental Organizations (NGOs);

3. Understanding the culture and the likely reactions of the population (in-depth knowledge of local population);

4. Conducting a legal analysis of the proposed operation to ensure that CF members are operating within an established legal framework;

5. Looking for second and third order effects that may occur as a result of actions either taken or not taken;

6. Anticipating the military responses to crowd confrontation situations during operations.

Force employment

If a decision of force employment is received from a competent CF authority, the military commander will decide, with the local authorities, where his forces should be concentrated and where to deploy if disturbances occur. According to the doctrine document [DND, 2003a], the CF should agree with the local authorities on a location near the scene of the incident, a best route to reach it, an estimate of the size of the crowd, its intentions, temper, weapons (if any) and capability, any relevant topographical details including lighting problems at night, the method of handling the crowd, the direction in which the crowd should be dispersed and the nature of move of CF (overt and massive or unobtrusive) with or without show of force. The presence of interpreters to make announcements when necessary and a prior assessment of cultural aspects of the local population are essential, particularly in assessing the most likely effects and potential second and third order effects of control measures.

Force deployment

According to the doctrine document [DND, 2003a], if disturbance becomes serious and the local authorities are losing or have already lost control, military forces must be grouped and moved in by the shortest route; neither personnel nor vehicles must be employed singly. Forces should be brought to the scene of disturbance when their intervention is required. If they arrive too early, the crowd may either find their presence provocative, or it may get used to them and think that no stronger measures will be used.

[DND, 2003b] presents tactics of deployment, which include pre-emptive techniques for influencing aggressive crowds, force extraction skills, the deployment of non-lethal weapons (NLW) and the deployment of deadly force if necessary and reasonable in the circumstances. Throughout CCO, crowd influencing techniques may prove to be the most effective tools. The value of warning and persuasion, without the use of force, is important, particularly when directed at leaders, and the use of the minimum necessary force must always be kept in mind.

When dealing with an aggressive crowd, the following initiatives are proposed in [DND, 2003a]: (1) establish contact with the appropriate civilian law enforcement authorities; (2) establish contact with senior town officials; (3) keep civil police in front if a crowd gathers; (4) confiscate weapons from unauthorized persons; and (5) get photos and video of participants, particularly agitators; (6) isolate any locations, particularly weapons storage sites that could exacerbate the situation; (7) deny ingress into the disturbance site; (8) counter a misinformation campaign; and (9) ensure protection to prevent rioters from encircling the control forces.

Actions taken by CF personnel depend on the behaviour of the crowd. The documents on doctrine and CCO tactics [DND, 2003a; DND, 2003b] categorize the stages of disorder and likely crowd behaviours, and presents for each of them some advice concerning the military involvement (see 0 for details). The stages of disorder follow the following pattern: normality → high tension → sporadic disorder → riot → serious riot → lethal riot → immediate post riot → community unrest → normality. Crowd behaviours vary from minor aggression to rioting. A minor aggression consists of creating disorder by throwing stones and other projectiles. Such an activity is likely to cause damage to property or serious personal injury. All troops may have to deal with minor aggressions and it is important that such incidents are controlled in order to prevent unnecessary escalation. Rioting consists of prolonged and organized violence usually in response to specific events. To deal with riot, the likely military activity is crowd dispersal (contained dispersal or active dispersal). Contained dispersal aims at preventing access by the crowd to high value or volatile areas. Active dispersal consists of dispersing the crowd along a pre-determined route.

During the conduct of CCO, CF personnel must adopt an attitude that will not further aggravate the crowd behaviour. The image of a professional disciplined soldier doing his duty under difficult conditions should be portrayed. Soldiers should also avoid any inflammatory behaviour.

CCO Operational Hierarchy

[DND, 2003a; DND, 2003b] define the following CCO activities that may occur sequentially, concurrently, or in isolation from each other. The following definitions are given by [DND, 2003b]:

Crowd Monitoring - "Crowd monitoring consists of activities to study, predict, observe and report on potential and actual crowds"

Crowd Avoidance/Prevention - "Crowd avoidance consists of activities aimed at minimizing contacts with a crowd while prevention aims at avoiding that a crowd assembles"

Crowd Disengagement - "Crowd disengagement consists of activities to separate a military force from a crowd, or to extract a specific person or group from a crowd"

Crowd Control - "Crowd control consists of activities to physically alter the action and behaviour of a crowd".

Crowd Dispersal - "Crowd dispersal consists of activities to break up a crowd".

Crowd Manoeuvring - "Crowd manoeuvring consists of activities to manage the movement of a large crowd such as refugees as a whole entity. It may encompass some or all of the other CCO activities but is not foreseen as a likely task".

3.1.3 Equipment for crowd confrontation operations

A CCO requires many capabilities, which can be obtained through the use of non-lethal weapons (NLW) and equipment. The CCO equipment may include personal protective equipment (e.g. face shields and protective body shields), non-lethal impact weapons (e.g. batons, baton round and water cannon), non-lethal short-range weapons (e.g. pepper spray and chemical irritants), and ancillary equipment (e.g. barricades, voice-amplifying devices, high intensity searchlights). Other CCO equipment consists of video and cameras and potentially dogs. Section 4.3 gives more details on the NLW aspects of the CF doctrine.

3.1.4 Legal considerations

Whether a CCO is domestic or international and whether it takes place in peacetime or during an armed conflict, the use of force (in term of intensity and duration) during the operation is subject to legal considerations. These legal parameters are defined in the Canadian domestic law and in the international law. The sources of **international law** include treaties, conventions, agreements, international court rulings and customary international law. The two primary components of international law are the Law of Peace and the Law of Armed Conflict (LoAC). The legal basis for the use of force during domestic operations is the **Canadian law**, particularly as found in the Criminal Code of Canada (CCC). The use of force depends on the legal mandate of the CF involvement and the RoE. The RoE define the circumstances and limitations within which force, including NLWs, may be used to achieve military objectives. Further discussion of the legal basis for the CF is found in [DND, 2001].

3.2 Police doctrine

In Canada, crowd situations are complex to manage because of the fact that the police responsibilities are shared by the different levels of government. Actually, either municipal, provincial/territorial or federal law enforcement agencies intervene to deal with crowd control situations. Each of them has its specific doctrine and tactics. To give some understanding of the content of police doctrine, this section stays generic without referring to a specific police agency. Mostly, the information provided in this section is extracted from documents of the Ottawa Police [Ottawa Police Report, 2002], Ontario Provincial Police [OPP, 2006] and the Canadian police institute [Lebeuf and Soulli re, 1996].

3.2.1 Objectives

The aim of the police is to proactively manage crowds at all levels of order (i.e., from peaceful to confrontational). When managing crowds, the responsibilities of police, defined in [OPP, 2006], are to:

1. Protect members of lawful and peaceful assemblies;
2. Protect lives and property of citizens;
3. Prevent a breach of the peace;
4. Use minimal force.

According to [Ottawa Police Report, 2002], the objective is to optimize public safety, preserve the peace, enforce the law and provide quality service in partnership with the communities while upholding the fundamental freedom of peaceful demonstrators. All actions to be taken should respect rules of law, openness and accountability, and ethical and professional standards.

3.2.2 Conduct of crowd control

The planning of crowd control: proactive measures

The planning process for crowd control should begin as early as possible. Some activities are expected to be done as proactive measures [Lebeuf and Soulière, 1996], for example developing an organizational philosophy to manage crises from an operational standpoint, making sure that the media are properly informed of the developments of the gatherings, promoting response planning and team coordination, drawing up a communication plan prior to the responses with the groups wishing to express themselves publicly, providing proposals for mobile response units, having a written plan concerning civil disorder, having the necessary and easily available logistic equipment (radio transmitters, car, etc.), having developed a good communications system among the various authorities involved and, finally, to provide adequate training.

During the planning process, effective strategies and tactics (that avoid the potential for violence escalation) are reviewed. These strategies take into consideration the values and key objectives of the police. They include the use of technical aids like non-lethal weapons (including tear gas, rubber bullets and water), support units (canine, tactical, etc.) and the use of specific techniques such as arrests. Moreover, these operational plans should respect statutory requirements, be clearly communicated to the public and be consistently applied.

However, when a crowd situation arises, more than technical issues (how to respond quickly and effectively) should be assessed. It is as important to assess how any necessary cooperation between police agencies can be organized and in what form. Cooperation among police forces imposes a certain number of constraints from an operational (how to proceed) and human (who will be in charge of the operations) standpoint [Lebeuf and Soulière, 1996].

The conduct of crowd control: police actions

For crowd control, the police have a variety of actions to consider. The following points summarize the main police actions, presented in [Lebeuf and Soulli□re, 1996]:

1. Collect intelligence with a view of planning response scenarios;

2. Assess the overall situation to make the best decisions at the right time;

3. Establish communication strategies among the participants (the police, the government, the media), find out the names of the persons in charge of the event and communicate with them;

4. Learn facts about the movements of the crowd and the ability to assess them;

5. Assess the responsibilities from a senior management standpoint and appoint an officer in charge of the management of the gathering and, therefore, have an established command structure;

6. Coordinate the movements and actions of the various police forces involved;

7. Make sure that extra police back-up is available;

8. Make use of verbal bargaining before making any move;

9. When necessary, resort to strong-arm response techniques by using force and crowd control techniques;

10. Have the ability to move quickly;

11. Set up specialized teams to carry out mass arrests.

3.2.3 Legal considerations

Sections 66, 65 and 68 of the Canadian Criminal Code, grouped in Part II of the Code under the heading □*offences against public order*□, give the legal basis for crowd control in Canada.

3.3 Analysis of protest policing

Some papers, mostly in the field of psychology, have analysed crowd control tactics and strategies [Stott and Reicher, 1998; Reicher *et al.*, 2004; Adang and Cuvelier, 2001; McPhail *et al.*, 1998; McPhail and McCarthy, 2004; Cronin and Reicher, 2006]. This section summarises the main criticisms. Issues related to the heterogeneity of the crowd, the accountability concerns of the police, the interactions between the police and the crowd, and the adaptability of each are discussed.

Heterogeneity of the crowd - Psychologists that have analysed crowd control policing agree on the importance of not considering the crowd as a homogenous entity for the planning and the

conduct of crowd control. [Stott and Reicher, 1998] reports the results of 26 interviews with public order trained police in order to understand how the police view the crowd. The analysis shows that even if the police perceive the crowd as a heterogeneous entity, their tactics in situations of conflict consider all crowd members the same. According to [Stott and Reicher, 1998], such tactics contribute to escalating (if not initiating) collective conflicts.

Similarly, [Reicher *et al.*, 2004] argues that the classical view of all crowd members as being inherently irrational and potentially violent is both wrong and dangerous. It can lead to "policing strategies that respond to the violence of some in the crowd by clamping down on all members, and therefore lead all members to perceive the police as hostile and illegitimate". In that case, non violent members may feel that their legitimate actions are unfairly impeded by the police, and consequently that they can accept confrontation, integrate hostile groups and increase the level and scope of the collective conflict. Thus, even crowd members initially opposed to violence may become violent as a consequence of police tactics and strategies.

Moreover according to [Reicher *et al.*, 2004], the effects of such policing strategies are not limited to the crowd event itself. They explain that people who expect the police to uphold their democratic rights but feel that the police have denied these rights are often those who are most outraged, most angry and who enter subsequent crowd events with the greatest willingness to confront the police [Drury and Reicher, 1999; Drury and Reicher, 2000].

To avoid such consequences of police tactics, [Reicher *et al.*, 2004] recommends that police officers concentrate on understanding the collective identities, priorities and intentions of the different groups in the crowd and give the same priority to facilitating the lawful intentions of some groups as to controlling the unlawful intentions of others. Moreover, [Reicher *et al.*, 2004] advices law enforcement services to develop strategies that defuse the risks of violence. Some authors argue that a more customized response, keeping with the spirit of a non violent gathering can yield noticeable results. Indeed, the need to treat different sections of the crowd in different ways is crucial [McPhail *et al.*, 1998; Waddington, 1994].

Accountability - [Cronin and Reicher, 2006] examines the decisions made by senior officers during a simulation exercise of a crowd event. The analysis shows that officers are deeply concerned about their accountability to a variety of audiences (internal and external to the police force). This pressures them to sometimes act in contradictory ways. They suggest that changes in accountability could be beneficial.

Interaction between the police and the crowd - Many authors agree on the importance of explaining the crowd behaviour not only in terms of processes internal to the crowd itself but also in term of the evolving interactions between the police and the crowd [Koopmans, 1993; Della Porta and Reiter, 1998; McPhail *et al.*, 1998, Stott and Reicher, 1998; Reicher *et al.*, 2004; McPhail and McCarthy, 2004]. [McPhail and McCarthy, 2004] explains that neither the crowd nor the police initially have violent intents. But, the outcome of their interactions is violent because each set of actors pursues its own interests, and thus defends them against the other party. Consequently, police members should enhance their understanding of the consequences of these inter-group relations before developing tactics for crowd control.

Adaptability - Several studies of protest and repression [Lichbach 1987; Gupta *et al.*, 1993; Francisco, 1995; 1996] established that crowd members adapt their tactics to variable type of

police repression. In contrast, it is recognized that the police have difficulties in adapting to innovative protest tactics, variability, mobility and any other variable that reduces the capacity of the police to predict where, when, how and under what circumstances the protesters will choose to confront them [McPhail and McCarthy, 2004].

3.4 Literature propositions for protest policing

This section presents the main guidelines proposed in the literature for public order policing. These guidelines and recommendations are gathered from academic papers and governmental reports. Key recommendations are related to communication, facilitation, differentiation, education and training, intelligence gathering, coordination in joint operations, arrest, search and seizure procedure, support and specialty units.

Communication [Reicher *et al.*, 2004; Adang and Cuvelier, 2001; Ottawa Police Report, 2002]

[Adang and Cuvelier, 2001] analysed different policing strategies and show more specifically the impact of communication with the crowd. They conclude that if the police approach was to maintain distance, to avoid informal interactions and to treat the crowd in general with caution, then hostility was far greater than in cases where officers interacted with crowd members in a friendly and open way. In addition, [Reicher *et al.*, 2004] agrees that members with no illegal or hostile intent will try to communicate and to separate themselves from hostile groups. They even can try to stop acts of aggression seen as illegitimate. Such communication strategies have a critical impact on the relationship between different groups in the crowd and on the evolution of the conflict (whether it stays contained and isolated or whether it escalates into a generalised crowd confrontation). The nature of the message that is communicated to the crowd is important. If the police are seen as favourable to the pursuit of legitimate aims by crowd members, then these members are likely to listen to the police and ignore those calling for confrontation. It is also important to have mediators available to communicate at moments of high tension.

In the same way, [Ottawa Police Report, 2002] argues that good communication is a critical prerequisite for effective crowd control policing. This includes the communication of information within the police service, the communication between different agencies in the case of joint operations, and the communication of information to the public, the media and all participants. In particular, sufficient attention and resources should be applied to communication between the police and the event organizers before and during the event.

Facilitation [Reicher *et al.*, 2004]

Facilitation consists of treating crowd members from the perspective of "how can we facilitate them?" rather than "how can we frustrate them?" Policing should be organised such that the legitimate aims of crowd members are enabled.

Differentiation [Reicher *et al.*, 2004]

Differentiation refers to the importance of not treating all crowd members as the same. It is precisely when some crowd members start to be hostile that it becomes important to treat the non violent crowd members in a friendly way. Differentiation should be kept in mind in training, planning, equipping, briefing and operating in crowds [Reicher *et al.*, 2004].

Education and training [Reicher *et al.*, 2004; Ottawa Police Report, 2002]

Education about the social identities of sub-groups in the crowd is essential. More specifically, it is important to learn about their values, standards and goals, their sense of what is right, their stereotypes and expectations from other groups, their history of interaction with these groups, etc. [Reicher *et al.*, 2004].

In addition to information about protest groups, there is a need to conduct training on special equipment, policing techniques, civil rights and charter rights; non-violent civil disobedience techniques; arrest methodology; anger and provocation management; negotiation techniques; mass-psychology and crowd behaviour; and collaborative management of crowd dynamics.

Intelligence gathering [Ottawa Police Report, 2002]

Intelligence gathering is a necessary element of policing. Nevertheless, intelligence gathering should not undermine the potential for dialogue between the police and the protest organizers during the planning phase, or replace ongoing communication during an event. Moreover, limitations concerning the access to public spaces should be set at the earliest possible date.

Coordination in joint operations [Ottawa Police Report, 2002]

If more than one police service is involved, the overall command structure should be clear to all law enforcement personnel as well as to the public. A set of policies and protocols for all agencies and officers should be established.

Arrest, search and seizure procedure [Ottawa Police Report, 2002]

The handling of arrests should be done in accordance with the legal process. Actions and tactics that will result in possible arrests should be communicated to protest organizers during the pre-event dialogue and to participants during the event itself. Decisions regarding arrests and search and seizure should be guided by statutory requirements. In addition, the potential impact of an arrest on the crowd dynamics should be kept in mind.

Support and specialty units [Ottawa Police Report, 2002]

Specialty units (e. g. canine units) play important roles in crowd control policing. In order to minimize fear and the potential for escalation, these units and their technical aids should keep a low profile until deployment is required.

4 Non-lethal weapons

This section provides an overview of the topic of non-lethal weapons (NLW). Two main areas are covered: the current and desired capabilities that will allow the NLW to fulfill their intended role, and the challenges that may prevent them from fulfilling that role, either totally or in part. In addition, a brief summary of the Canadian doctrine with respect to non-lethal weapons for crowd confrontation operations is also included in this section.

4.1 Current and desired capabilities

4.1.1 Definition of non-lethal weapons

During the several decades of existence of non-lethal weapons, many attempts to define them have been made and a few controversies on the subject have occurred. [Lewer and Schofield, 1997] provides a good coverage of the various definitions of NLW and the additional terms that are employed to describe them, such as less-than-lethal, disabling, soft-kill, pre-lethal and worse-than-lethal. It can be seen just from the terminology that non-lethal weapons have their proponents and opponents. Controversial aspects aside, there is one definition that is currently generally accepted within NATO countries, which is the following:

NLW are weapons that are explicitly designed and primarily employed so as to incapacitate personnel or material, while minimizing fatalities, permanent injury to personnel and undesired damage to property and the environment.

In summary, there are two main characteristics that distinguish non-lethal weapons from their lethal counterparts: first, the intent not to kill (for the counter-personnel weapons) or not to destroy (for the counter-materiel weapons) and second, the desire to have reversible effects.

4.1.2 Areas of application of non-lethal weapons

The main role of NLW is to help establish a force continuum between merely maintaining a military presence and employing a deadly force. The non-lethal weapons fill the gap between these two extremes, and provide more options of response to a commander in the field. Thus, they allow for a better match between the level of threat and the level of response to that threat, which in turn diminishes the risk of unnecessary escalation of a situation.

[Rahimi *et al.*, 2005] identifies peace operations, including peace enforcement operations, peacekeeping operations and humanitarian assistance operations, as an important area of applications for NLW. More specifically, NLW are believed to have a positive impact in dealing with challenging situations such as controlling mass demonstrations and riots, operating checkpoints, escorting vehicles and people, patrolling an area, searching houses, distributing humanitarian aid, denying access to some area and guarding buildings and areas. Those are the areas that have been the most widely recognized in the literature as potential areas for the employment of non-lethal weapons.

[Davison and Lewer, 2004] sees also a role for NLW in combat operations, in situations where combatants and non-combatants have been deliberately mixed, or during military operations in urban terrain, for example, when part of the local population may choose to remain in the area. Traditionally, in such situations the military had no other option than to operate under very restrictive rules of engagement, and accordingly paid the price in terms of the effectiveness of the operation. Usage of NLW is expected to significantly alleviate such shortcomings.

[Alexander, 2003] advocates the usefulness of NLW in counterterrorist situations, when there is a need to incapacitate one or several terrorists operating from within a larger group of harmless individuals. In such instances, minimizing the collateral damage becomes critical, making NLW ideal candidates to tackle situations like these.

[Annati, 2003] addresses the requirement for NLW in a *maritime context*. The five main areas where NLW can answer specific maritime requirements are boarding operations, arrest of surface vessels, protection of shore areas from sea-borne threat, protection of naval vessels while pierside, anchored or in slow motion close to shore and contribution to "traditional" naval warfare and ship self-defence.

[O'Connell and Dillaplain, 1994] discusses the non-lethal concepts in an air force context, identifying several technologies that have potential air-power applications. The same objectives are sought with airborne NLW as with non-airborne ones, namely fewer casualties and less collateral damage.

4.1.3 Types of non-lethal weapons

An extensive body of literature exists that characterizes and classifies the different types of non-lethal weapons or describes specific examples of NLW. Among such papers, [Grieger, 2003] and [Davison and Lewer, 2003] provide quite comprehensive reviews of the various non-lethal weapons technologies. An updated version including the latest developments in the domain is available in [Davison and Lewer, 2006]. The following summary, compiled based on these documents, identifies nine categories of NLW, classified by the type of technology employed:

Electrical - Electrical weapons are designed to incapacitate personnel on a temporary basis, by delivering a high voltage, low amperage shock to the body. Examples of such weapons include stun guns, stun batons, electrified shields, electrified nets, "sticky shockers", stun belts, and Taser guns, the latter being probably the best known device in this category.

Kinetic Energy - The kinetic energy weapons were amongst the first NLW developed. They are designed to physically disable a person on a temporary basis, by releasing a high amount of energy to the targeted individual on impact, with a minimal risk of injury. Examples include impact munitions (or impact projectiles), water cannons (portable or mounted on vehicles) and the Vortex Ring gun. The impact munitions have been categorized by [Kenny *et al.*, 2001a] in seven broad classes: airfoil, baton (foam, plastic, rubber, Styrofoam, wooden), drag-stabilized projectiles, encapsulated projectiles, fin-stabilized projectiles, pads (rectangle and round) and pellets (single, multiple large, multiple small).

Electromagnetic - These weapons use electromagnetic waves to incapacitate a person for a limited amount of time or to degrade/destroy materiel. For example, the Active Denial Systems

employs a beam of millimetre wave electromagnetic energy to heat the skin of an individual in its path. The High Power Microwave weapons deliver a burst of electromagnetic radiation designed to destroy electronic equipment. Another example of weapons in this category is the laser dazzler, designed to temporarily disorient a person by means of a blinding light.

Acoustic - Acoustic weapons employ audible sound, infrasound or ultrasound to incapacitate/disorient a person by causing pain in the ear. These weapons are currently subject to significant criticism, due to their (still) high risk of producing some permanent damage to hearing.

Mechanical - Barriers, entanglements, nets, obstacles and spikes are examples of weapons in this category. A number of barrier systems have been developed for stopping vehicles. Rigid foams have been developed to use as a barrier to deny access to a building, for example. Nets fired with a launcher or sticky foams fired with a gun have been proposed as counter-personnel weapons.

Chemicals - There are several classes of chemical agents that can serve as non-lethal weapons. The Riot Control Agents (RCA), of which the most commonly known are tear gas and pepper spray, are designed to disperse, discourage and incapacitate members of the crowd by causing irritation to the eyes or skin, headache, dizziness, nausea, etc. Other chemical substances that can be included in the RCA class are tranquilizers, sedatives and malodorants. Depending on the delivery option selected (12 gauge cartridges, 38 and 40 mm cartridges, aerosol cans, grenades, etc.) these chemical weapons may or not discriminate between targets. There are also a number of chemical compounds that are designed to be used against materiel, such as fuel contaminants, corrosive agents or anti-traction materials (slippery substances that are used against vehicles).

Biological - This category has been included for the sake of the completeness of this classification, but development of biological agents that can cause a deterioration of food, water, equipment or materiel of any kind is actually against the law in many countries.

Ancillary - The ancillary technologies include markers (dyes liquid, foam, smoke; fluorescent,; invisible UV light visible; paint ball guns), non-lethal casings, encapsulants and taggers.

Combined Technologies - A significant trend in non-lethal weapons development is combining one or more technologies into a single weapon. Examples of such systems include the PepperBall system (kinetic and chemical), water cannons (kinetic and chemical/electrical), foam barriers that use chemical agents (mechanical and chemical) or flash-bang devices (electromagnetic and acoustic), to name a few.

4.2 Challenges

4.2.1 Effects of non-lethal weapons on humans

The issue of identifying and acquiring sufficient knowledge about the effects of non-lethal weapons on humans is very complex. Among the factors that contribute to this high level of complexity, the following can be mentioned:

1. The requirement to evaluate both the short-term effects and the long-term ones. By the very definition of NLW, those weapons need to be effective (i.e., have the desired short-term incapacitation impact) but they also need to have reversible effects (i.e., have no long-term impact at all).

2. The diversity of the non-lethal weapons. Section 4.1.3 provided a brief overview of the various types of NLWs. However brief, this overview is nevertheless suggestive of the endless possibilities of development of such weapons.

3. The fact that there are several types of effects that need to be considered, the most important ones being the physical effects and the psychological (behavioural) effects.

4. The absence of a central database. A recent report [NATO HFM-073, 2006] documents many of the issues related to the effects of NLW on humans. It concludes that, although there is a great need for a database covering these aspects, for multiple reasons a database is not likely to be created in the near future.

Physical Effects

Most studies tackling the issue of the effects of NLW on humans are addressing the issue of the short-term physical effects. The main reason for that is that such studies are required in order to prove that the weapons actually work the way they are intended to, which is a necessary step before the commercialization of the weapon.

Examples of such studies are [Risling *et al.*, 2001] concerning the effects of High Power Microwaves on the Central Nervous System, [Makukhin, 2001] tackling the influence of laser radiation on humans, [Khrupkin and Savostyanov, 2003] addressing the medical impacts of gas weapons, or [Buguet and Jacquet, 2005] focusing on the neurophysiological aspects of the Advanced Taser, to name only a few.

However, although there have been many attempts to identify and measure the physical effects of non-lethal technologies and undoubtedly some progress has been made, the concluding remarks in most of these studies mention that more research is necessary to either fully understand the observed effects or to explore new avenues that may lead to the discovery of additional effects.

Understanding of the long-term effects of the NLWs is even more challenging due to the scarcity of the data required to perform such studies.

An additional difficulty is created by the current lack of standardization in data collection and research protocols, which makes it difficult to re-use data collected by other organisations. However, a recent international effort aims to alleviate this shortcoming by the creation of the International Less Lethal Weapons Database, which is being developed by the UK Home Office, Police Scientific Development Branch and which aims to provide original, open source material related to less lethal weapons [Symons, 2005].

Psychological Effects

[Silver, 2006] states that psychological and behavioural effects are of outmost importance in the case of non-lethal weapons (unlike their lethal counterparts), and deplores the fact that most research conducted on the effects of NLW deals with ballistic and safety effects or assesses the physical incapacitation of the targets. This study proposes two new models of reactions to the use of non-lethal weapons, one for the recipient of the attack (i.e., the target) and one for the observer (i.e., the bystander). The significance of the behavioural effects is also acknowledged in [Heal, 2005], which describes a comprehensive study based on data collected from 1995 to 2004. A component of this study aims at describing the range of bio-behavioural effects of NLW use, including desired and achieved behaviour changes. An earlier work [Kenny *et al.*, 2001a] documents the need to consider psychological aspects when employing NLW in situations of crowd control. [Gozna, 2001] calls attention to the cultural implications of non-lethal weapons deployment and to how the reactions to the use of the same weapon may be different in different regions due to such factors as religion, language, norms and values. [Griffioen-Young and Janssen, 2001] describes a TNO effort of reviewing open-source literature on the physical, psychological and behavioural effects of seven NLW technologies. Among the notable results of this study, there is the graphical representation of the selected set of NLW technologies that allows for a comparison between them according to the intensity of their effects along the psychological and physical dimension.

In summary, the need to consider psychological aspects, including the psychological effects of NLW, has been convincingly demonstrated in the literature. However, more effort is required to continue augmenting the body of knowledge in this domain and to validate some of the conclusions obtained in previous studies.

4.2.2 Evaluation of the effectiveness of non-lethal weapons

The effectiveness of any weapon system is a critical factor in the planning phase, when capability requirements are assessed, in the acquisition phase, when a decision needs to be made regarding the selection of weapons to be bought, as well as in the deployment phase, when a commander needs to decide on the strategy and tactics of an operation. Data on weapon effectiveness would also be appreciated by analysts and modellers who are tasked with comparing various weapon systems or with establishing various measures of performance. However, evaluating the effectiveness of non-lethal systems is not an easy task.

[Verhagen, 2000] presents a methodology that is based on the assessment methods used for lethal systems. This methodology aims to develop an integrated tool that would allow for the comparison of different non-lethal and/or lethal systems in a consistent manner, using the same platform. The focus of the study is limited to the assessment of the effectiveness of lethal and non-lethal systems, with respect to a single personnel target. Although this study provided an important first step towards the development of such a methodology, some "building blocks" are still missing, and therefore, more effort would be required in order to fill the gaps and increase the practical value of the proposed framework.

[NATO SAS-035, 2003] presents a comprehensive methodology that would allow for an assessment of the effectiveness of the whole range of non-lethal weapon systems (electromagnetic, chemical, acoustic, mechanical, kinetic and ancillary), as well as for lethal

weapon systems, applied against personnel or materiel targets. For a successful implementation of this methodology though, data regarding the effects on the targets are required and these data are currently lacking. To address the issue of data requirements, a follow-up study is now undertaken (SAS-060), but no report is yet available.

Given the challenges encountered in understanding the effects of non-lethal weapons on humans, and given the fact that a reasonable understanding of these effects is a pre-requisite for an operational effectiveness assessment methodology, it follows that developing this methodology is particularly difficult.

4.2.3 Legal issues and acceptability

[Vanheusden, 2005] explains that the use of weapons, and the means or methods of warfare can be prohibited or restricted by one or more rules in international law, and more precisely in international humanitarian law and human rights law.

The four principles in international humanitarian law that are applicable to the use of weapons, and which are described in more detail in [Vanheusden, 2005] are the following:

1. The principle of superfluous injury or unnecessary suffering;

2. The principle of discrimination;

3. The principle of proportionality;

4. The De Martens clause.

Human rights law protects citizens against their own state authorities or against foreign state authorities, in peacetime or during an armed conflict. It has been identified as a human rights law obligation to equip police or other forces used against crowds and riots with non-lethal weapons, because they allow for a gradual response. Without these, an execution of the mission could lead to a violation of human rights law.

[Vanheusden, 2005] also includes examples of non-lethal weapons and where they stand with respect to international law. Flash-bang hand grenades, smoke hand grenades, telescopic truncheons, stun guns and tasers are identified as legal when used in a normal, expected way. Other weapons such as dazzling lasers are more in a grey zone, where they are not restricted as far as the intention is not to permanently blind the enemy, while other laser weapons, designed to cause permanent blindness are banned. Examples of prohibited weapons include some microbes capable of degrading fuel, an herbicide (□Agent Orange□), as well as non-lethal anti-personnel mines.

It is concluded that a rigorous legal review process should be conducted for many other non-lethal weapons that raise questions in order to determine potential restrictions or prohibitions to their use.

[Bagdasaryan *et al.,* 2005] presents results of an investigation conducted in Russia on the social acceptance of non-lethal weapons. The investigation concluded that the social acceptance of

NLW development and deployment was not always predictable. In addition, it pointed out that a multi-disciplinary approach involving scientists, medical and legal representatives as well as mass-media specialists, is recommended to improve the social acceptance of non-lethal weapons.

4.3 Non-lethal weapons in the Canadian Doctrine

Section 2 of Chapter 6 of the Crowd Confrontation Operations Doctrine, published in 2003, is dedicated to the subject of lethal and non-lethal weapons and their potential employment in crowd confrontation situations.

In this document, non-lethal weapons are seen as a means to expand the number of options available to commanders to deal with situations when the use of deadly force poses problems. However, it is specifically mentioned that the availability of non-lethal weapons should not limit the self-defence capacity of soldiers and that NLW are a complement to deadly force. NLW are always to be backed up by lethal weapons and the commanders in the field must have the authority to use lethal force. In addition, it is acknowledged that when non-lethal weapons are used, casualties, including fatalities, could ensue.

Categories of NLW that were identified in this document as being suitable for crowd confrontation operations include:

1. *Impact weapons*, such as the traditional baton as well as non-lethal impact rounds (e.g. 40 mm sponge grenade and the 12 Gauge bean bag) or electronic shock dart pistols (e.g. Taser 21);

2. *Water under pressure*, that can be projected from water cannons or fire hoses, and can be used as a dousing or as a jet;

3. *Riot control agents*, which are referred to in this document as "non-lethal short range weapons". They are chemical substances that generally cause irritation of the eyes or skin, choking, coughing, etc. These irritants include OC (pepper spray), CN, Parva and CS gas and they may be delivered by riot gun, canister, grenade or spray, depending upon the type and the desired effect;

4. *Ancillary equipment*, such as barricades that may be used to channel a crowd into a particular direction or to deny access to certain facilities, caltrops that may be used to prevent vehicles from going a certain route, or high power spotlights that enable the identification of riot leaders in low light conditions.

This doctrinal document also touches on the subject of a Non-Lethal Capability Set, which would be used in the near future by units that need to deploy on missions that are likely to involve crowd confrontation situations, to enhance their force protection and to reduce non-combatant casualties.

Employment considerations for non-lethal weapons are also addressed, with three main areas covered:

1. *Principles of employment* (authorization; complement to deadly force; legality; variable response capability);

2. *Planning considerations* (consider the possible responses of the crowd, including counter-measures that a target group might employ to negate the effects of NLW);

3. *Training and organisation* (as much as possible, NLW should be compatible and easily integrated with current and planned conventional weapons; training must be readily integrated into current training activities; use and maintenance of these weapons should not require commanders to make major alterations to the organisation of their units).

5 Conceptual model for crowd behaviour

In this section, a conceptual model is proposed, to explain the behaviour of individuals in a crowd, in the presence of control forces. This model can be viewed as a conclusion summing up the literature review presented in the previous sections of this document. It represents an attempt to link together into a coherent structure those variables that stood out as significant factors influencing the behaviour of individuals in a crowd. This integration effort was not obvious though, due to the fact that there are several points on which researchers were not able to reach a consensus, and for which the authors had to make their own subjective choices. Therefore, the conceptual model discussed here is proposed as a starting point, in need of additional validation. The objective is for this model to be used in the future research efforts of the team, to build a crowd control modelling and simulation tool. The process of validation of this tool will also include aspects of validation of the model proposed here. The model will then be reviewed, upon completion of this validation process.

This section begins with a brief definition of the variables that are considered in the conceptual model. Then, the assumptions of the model, i.e., the relationships between these variables, are formulated. Again, these are starting assumptions for the current project, that will be subject to further review and validation. Finally, a graphical representation of the conceptual model is included.

5.1 The variables

The variables considered in the conceptual model are the following:

Personal Factors - These consist of characteristics such as gender, age, socio-economic status, ethnicity and culture. Most of these are self-explanatory. Culture is an umbrella term that is used as a means to express how the behaviour of an individual is influenced by his/her education, religion, history, etc.

External Factors - These consist of elements that cannot be controlled by the individual, such as time (i.e., time of day, or time since the beginning of the event), the environment, or the weather.

Facilitating Factors - These will facilitate or hinder the occurrence of a behaviour. Examples include the presence of weapons or protection equipment, alcohol, drugs, presence of media, and previous experience with demonstrations. Physiological needs (fatigue, hunger, etc.) could be examples of impeding factors.

Emotional State - This refers to how an individual *feels* (psychologically). Emotions such as frustration, fear, panic, hostility, anger or joy, to name a few, can have a significant influence on the behaviour. In a crowd, emotions vary among the individuals and can change rapidly depending on the situation.

Cognitive State - This refers to what an individual *knows.* It represents the amount of knowledge (information), real or perceived, that is available to the individual from all sources. It includes

previously accumulated knowledge (e.g. awareness of the effects of a gas bomb) and real-time information (e.g. a gas bomb had just exploded in certain place).

Physical State - This refers to the physical condition of an individual. Some of the factors that affect it are fatigue, hunger, or physical injury (by a non-lethal weapon, for example).

Social identity - This is a concept of self-identity by which an individual acknowledges internally that he belongs to a certain group (or to several groups) and consequently aligns his or her behaviour to the norms of the group. Changes in behaviour are thus being explained by changes in the social identity of the individual. There can be a change from a personal identity to a social identity, when the individual abandons some of his usual manners to take on those of the group, or there can be changes from one social identity to another, when the individual, for various reasons, can identify better with a new group.

Behaviour of individual/control forces/crowd - This refers to the actions performed by the individual/control forces/crowd. For analysis purposes, it has been considered useful to distinguish between actions whose purpose is to transfer information (e.g. making a speech, or spreading a rumour) and other types of behaviours (e.g. standing on a structure, or throwing a Molotov cocktail). The two categories will be identified in the context of this project as "communication" and "physical actions".

Communication - This is the act of transferring information between the various players involved, using any communication means available, such as word of mouth, cellular phones, megaphones, radio, written messages, etc. It is to be noted that communication may lead to a mixture of truth and non-truth which are passed along.

Physical Actions - This refers to all actions performed by individuals in the crowd or by members of the control forces, whose purpose is not to inform. Examples include arrests, use of non-lethal weapons, use of other types of weapons, blocking roads, fleeing the scene, etc.

Perception of behaviour by individual - This refers to the mental interpretation that one could make of what he observed in reality.

5.2 The assumptions

The working assumptions for the model proposed here are formulated further. The reader is reminded that all these assumptions refer to the context of a crowd control situation involving control forces and that *behaviours* constitute the central focus of the model.

Assumption 1: *The behaviour of an individual in the crowd is influenced by the individual's perception of the behaviour of other crowd members (those that he knows about), as well as that of the members of the control forces.*

In crowd situations, individuals tend to identify themselves with a specific group and then realign their behaviours with the group's norms, abandoning if necessary some of their usual behaviours. I.e., their definition of the self may change during the event, by abandoning their personal identity to take on a social identity.

Assumption 2: *Perception of reality (be it control forces actions or other crowd members behaviours) is influenced by personal factors and by external factors.*

The literature review showed that culture, for example, can play a very significant role in how facts are interpreted. For instance, control forces patrolling in vehicles may be interpreted as cowardice and become very frustrating in some cultural contexts, while it can have no bearing whatsoever in others.

Assumption 3: *An individual can have several social identities during the course of an event.*

For example, the perception of illegitimacy of the control forces actions can lead to a shift in social identity. It may induce an otherwise peaceful individual to become violent (i.e. the individual starts to believe that violence is justified under the circumstances and can more easily identify himself with a violent group and join in the actions of that group).

Similarly, the perception of illegitimacy of the behaviours of the members of the group to which an individual belongs, may lead to a shift in social identity.

Assumption 4: *A shift in social identity may be the result of a rational decision made by the individual taking into account mostly cognitive factors, or it may be the result of an impulsive decision when the individual is so overwhelmed physically or emotionally that these feelings take precedence over everything else (including any cognitive elements).*

An example of a rational decision leading to a shift in social identity is when an individual perceives that there are some material gains to be made (without any unpleasant consequences), and decides to go looting.

An example of an impulsive decision may be to start "running for your life", in the same direction as everybody else, for no other reason that the individual is in a state of panic and self-defence mechanisms take over. Such behaviours are sometimes labelled "irrational behaviours".

Assumption 5: *The reinforcement or extinction of a behaviour depends on its perceived consequences, as well as on various facilitating factors.*

An example of consequences potentially leading to reinforcement of a behaviour can be the feeling of empowerment, the feeling that one can "make things happen", that one can have such impact on the situation that will eventually lead to reaching the desired objectives.

An example of consequences potentially leading to an extinction of a behaviour can be arrests of individuals nearby who performed similar actions.

Factors that may facilitate (or impede) some behaviours include alcohol and drugs, which may remove some inhibitions, the presence of weapons and protection equipment, which may increase the propensity to become aggressive, or even the presence of media, which brings more subtle but often non-negligible effects.

Assumption 6: *An individual will decide on a course of action (i.e., a behaviour) depending on what he knows (cognitive state), and what he feels physically (physical state) or psychologically (emotional state).*

This statement represents an acknowledgement that all three elements are important factors that will influence behaviours. Most of the examples provided earlier can be used to justify this assumption. Although the assumption may appear obvious, the reality is that many models tacitly ignore one element or another. Psychological models focus on the emotional state which tends to become the main causal element in these models, physical models tend to focus on injuries and deaths, often taking the form of a war-gaming exercise, while cognitive models often make a strong rationality assumption that inherently negates all emotional impact, for example.

The explicit formulation of this assumption actually translates into a commitment to build a model that takes all these elements into account.

Assumption 7: *Communication (i.e. the act of transmitting information) plays a significant role in the development of the event, including the behaviour of individuals in the crowd.*

This statement refers to the communication between the members of the crowd, between the control forces and the members of the crowd or within the control forces, performed via means of communication such as word of mouth, cellular phones, megaphones, radio, written messages, etc.

Once again, the explicit formulation of this assumption translates into a commitment to build a model that can be used to assess the effects of good communication, or the effects of misinformation (e.g. rumours).

5.3 The model

The conceptual model represented graphically in Figure 1 aims to explain the behaviour of an individual member of the crowd, in a demonstration context, in the presence of control forces. The variables and the assumptions considered in this model were described in Sections 5.1 and 5.2 respectively. In this section the objective is to provide an improved understanding of the model by providing some additional details and examples.

The model is focusing on *one* individual member of the crowd and it describes how the individual's behaviour can be influenced by various factors.

The central part of the model (coloured in beige in Figure 1) can be used to explain an individual's behaviour in general, not necessarily in a crowd confrontation situation. It is based on the social identity theory, stating than an individual tends to self-identify with one or more social groups and then aligns his behaviour with those deemed acceptable by the members of that group (i.e. the norms of the group). The social identities that a person may take on may be long-lived or transitory, they may be dominant or minor.

Basically, this central part of the model reads as follows: An individual has some basic personality (or personal identity) and exists in a given environment (external factors). These two factors together make up the "lens" through which this person is perceiving the surrounding world. All interactions with the outside world are fed, via this lens, to the individual who is affected by them at three different levels: emotional, cognitive and physical. Based on some internal decision making process, the individual will then select the social identity that seems the most appropriate. With this selection, the person basically adheres "in principle" to a set of

behaviours (the group's norms). Then at any given moment, the person will carry out one behaviour or another within this set, depending on the perceived consequences of performing that behaviour, as well as on some potential facilitating factors. Performing a certain behaviour then becomes "a fact of the outside world" that may potentially affect all persons who are aware of it. In other words, the individual is both influenced by and influencing the outside world.

In a crowd confrontation situation, the assumption is that the individual will act following the same process (described above), in the specific case where the outside world is composed mainly of other crowd members and members of control forces. Some of the elements that are specific to this situation and that were included in the model, more or less explicitly, are the following:

1. The emotions can be very high, leading to what is sometimes labelled "irrational behaviour". In such cases, cognitive aspects or decision making processes seem to not count or not exist, with emotions alone being the drivers for some behaviours. For example, aggressive behaviour is sometimes a reaction to frustration. Confrontational behaviour may appear as a reaction to hostility. Panic situations may lead to what may appear as irrational behaviours.

2. Facilitating factors that are specific to crowd control situations include the presence of weapons or of various protection equipments, as well as feelings of anonymity (related to the crowd size and density, or to the position of the individual within the crowd[4]), of invulnerability, or of loss of responsibility.

3. Communication and transfer of information also have some elements that are specific to crowd control situations. For example, the fact that there are at least two (but possibly more) antagonistic groups involved will likely have a bearing on the quality of exchanges. People may tend to display an unusual amount of trust towards other members of their own group, and unusual amounts of distrust towards the members of the antagonistic group. In addition to that, most people in a crowd usually have a limited access to information. They mostly have to rely on what they can see or hear around them, and what they are being told by their neighbours. This translates into most people often having (potentially biased) information only on a limited portion of the overall scene, without access to the "big picture".

4. The tempo of the event may be accelerated. Things can happen fast and there can be several significant events occurring simultaneously. There is also a non-negligible probability for an individual to get injured, either by the control forces (who may have decided to make use of non-lethal weapons, for example), or by other crowd members in a situation of panic leading to a stampede, for example.

5. The process described as "internal decision making" in Figure 1 also needs to be defined in such a way to make it appropriate for crowd control situations. People are likely to use different decision making processes when they are looking to escape a fire, for example, or avoid getting arrested, than when they are selecting which car to buy next year. The authors suggest the implementation of what is known in the literature as "naturalistic decision making" ([Zsambok and Klein, 1997]), and include things such as self-defence mechanisms.

[4] An individual may feel more sheltered if it occupies a position that is farther away from the control forces.

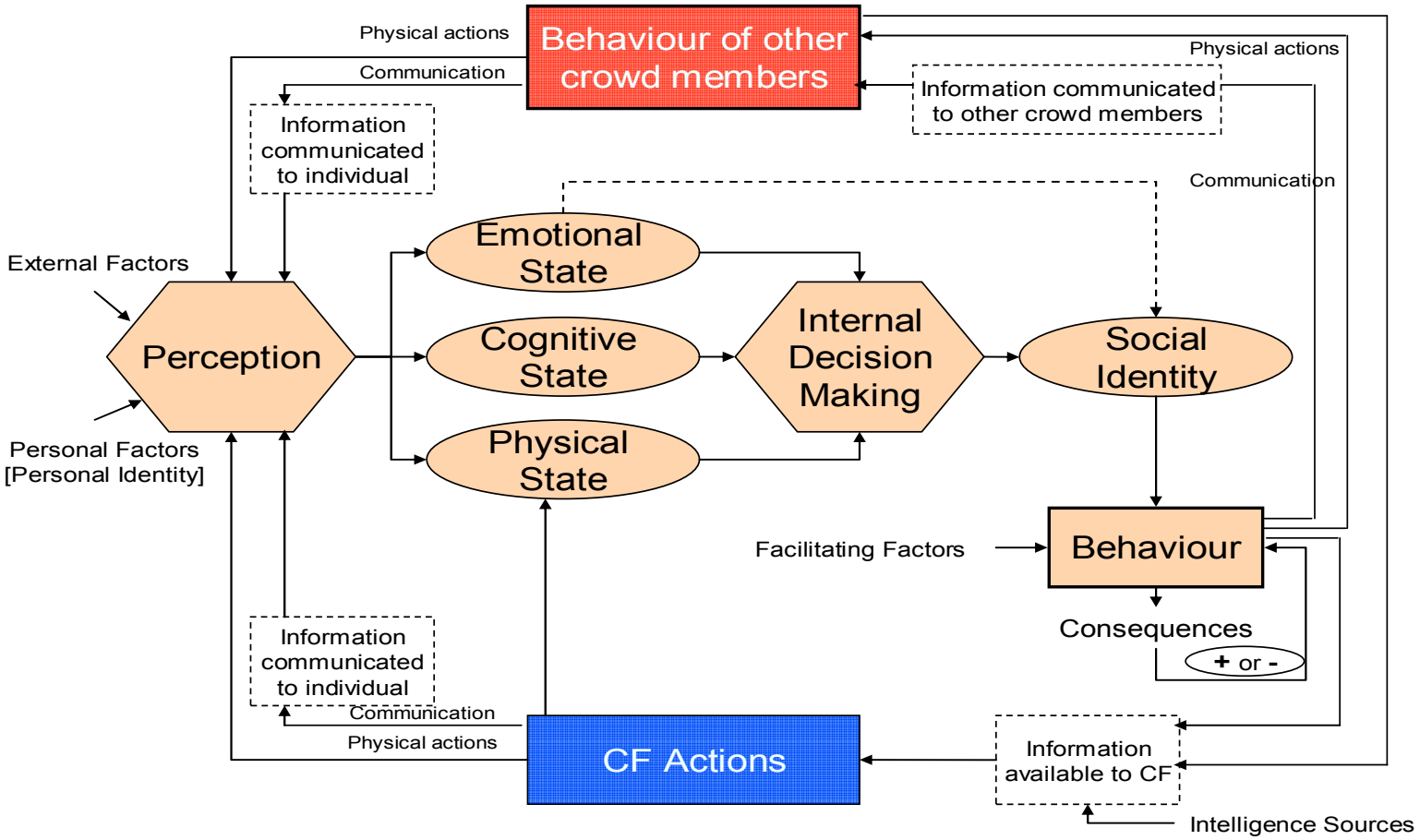

Figure 1: Conceptual model of an individual member of the crowd, in the presence of control forces

6 Conclusion

This report presents a comprehensive literature review in the area of crowd confrontation systems involving non-lethal weapons, covering three areas that are essential to understand such systems. First, several aspects related to crowds were reviewed. They include crowd-specific definitions, phases of crowd development, psychological aspects and a list of determinants of crowd violence. Second, control forces doctrine documents concerning crowd confrontation missions were summarized to provide a better understanding of the objectives, modus operandi, equipment and legal considerations characterizing these missions, both from a military perspective and from a police perspective. Third, the area of non-lethal weapons was explored, including an enumeration of the types of non-lethal weapons and their areas of application, as well as an identification of some of the challenges that still exist in this domain.

In addition to the literature review and based on it, an original model for the behaviour of an individual in a crowd in the presence of control forces was developed. This conceptual model is an attempt to link together into a coherent structure those variables that were identified by the literature review as significant factors influencing the behaviour of individuals in a crowd. Examples include *personal factors*, such as gender, age, ethnicity and culture, *external factors*, such as environment or weather, and *facilitating factors*, such as the presence of weapons, alcohol and drugs, or the presence of media. A set of seven assumptions is also provided, defining the mechanisms governing the behaviour of individuals in a crowd control situation. The model is proposed as a starting point for the future research efforts of the team aiming to build a crowd control modelling and simulation tool. Following some future validation process, the model will be reviewed.

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Annex A Crowd Behaviour and Defensive Counter-Measures

Figure A-1 reproduced from [DND, 2003b] presents the different stages of disorder, which follow the following pattern: normality → high tension → sporadic disorder → riot → serious riot → lethal riot → immediate post riot → community unrest → normality. During these stages, crowd behaviours vary from minor aggression to rioting. Crowd behaviours encountered during the stages: normality, high tension, sporadic disorder, immediate post riot, and community unrest are considered as minor aggression and Crowd behaviours encountered during the stages: riot, serous riot and lethal riot are considered as rioting.

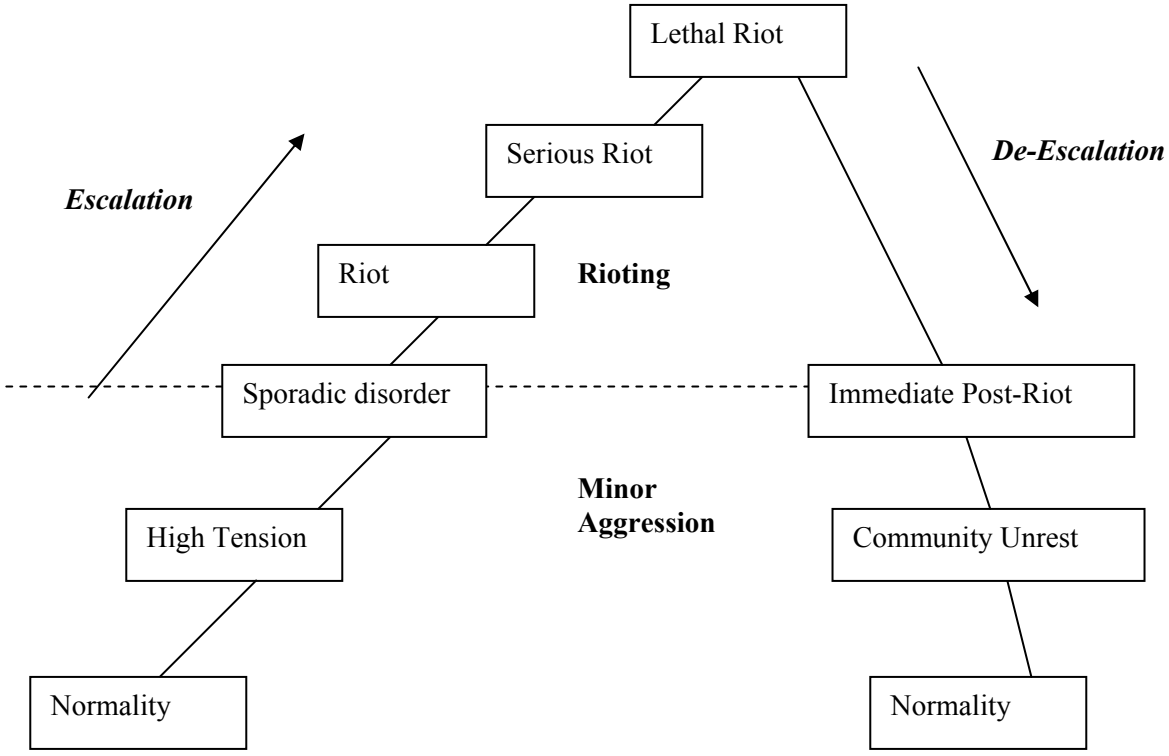

Figure A-1: Stages of disorder and level of aggression [DND, 2003b]

During each stage of disorder, the military forces should be prepared to intervene against each likely crowd behaviour. Table 1 presents some suggestions for counter-measures to crowd behaviour as proposed in the doctrine document [DND, 2003a].

Table A-1: Defensive counter-measures in CCO [DND, 2003a]

ACTION	COUNTER-MEASURES
Verbal Abuse. Obscene remarks, torments, jeers, and accusations.	Ignore verbal abuse.
Ridicule. Slogans on vehicles and installations, flowers placed in service rifle muzzles.	Provocation is not justification for retaliation. Restraint must be exercised until the offender touches the service person, at which time, non-deadly force may be applied, as authorized by RoE and Use of Force Summary Card.
Attacks. Gangs threatening, intimidating, or attacking detachments.	Orders for posts or patrols should detail immediate action for defence of detachments (e.g. remain in, or move to defensive area, call for assistance, apply the minimum force for defence, and identify leader for arrest and evidence purposes when help arrives, as authorized by RoE and Use of Force Summary Card).
Throwing Objects. Rocks, sticks, bottles, etc.	Remove or prevent access to source, if possible. Do not throw materials back at rioters and persons disturbing the peace. Possible actions include: withdrawal to better ground, absorb barrage while waiting for rioters and persons disturbing the peace to tire, intimidate by use of cameras, separate activists from spectators, arrest leaders, as authorized by RoE and Use of Force Summary Card.
Throwing Chemicals. Molotov cocktails, acid, etc. at personnel.	Step aside to avoid. Show restraint if not directly endangering troops or general public. Apply the minimum force necessary to prevent further attacks, detain as authorized by RoE and Use of Force Summary Card.
Molotov Cocktails. Against vehicle patrols.	Move out of range or provide close protection. Call for assistance. Locate, isolate, and apply the minimum force necessary to capture, or if action continues, apply force to prevent, as authorized by RoE and Use of Force Summary Card.
Molotov Cocktails and Grenades. Against vital points.	Ensure outer perimeter is beyond throwing range, if possible. Detain or prevent by applying the minimum force necessary, as authorized by RoE and Use of Force Summary Card.
Sniper Fire.	Call for assistance. Locate, isolate, and evacuate bystanders from area, neutralize the sniper using the minimum force necessary, as authorized by RoE and Use of Force Summary Card.
Random Weapon Fire. From within groups or mobs.	Call for assistance, and beware of panic from within group or mob. Identify, detain as authorized by RoE and Use of Force Summary Card.

List of symbols/abbreviations/acronyms/initialisms

APA	American Psychological Association
CCC	Criminal Code of Canada
CCO	Crowd Confrontation Operations
CF	Canadian Forces
CLS	Chief of the Land Staff
DND	Department of National Defence
DRDC	Defence Research & Development Canada
ESIM	Elaborated Social Identity Model
IPTF	International Police Task Force
LoAC	Law of Armed Conflict
NATO	North Atlantic Treaty Organisation
NGOs	Non-Governmental Organizations
NLW	Non-Lethal Weapons
RCMP	Royal Canadian Mounted Police
RoE	Rules of Engagement
SAS	System Analysis & Studies
TNO	Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek (Netherlands Organisation for Applied Scientific Research)
UNHCR	United Nations High Commissioner for Refugees

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This technical memorandum is written in the context of the Crowd Control Modelling and Simulation Capability Technology Investment Fund Project. It presents a comprehensive literature review in the area of crowd confrontation involving non-lethal weapons, covering three areas that are essential to understand such systems. First, several aspects related to crowds were reviewed. They include crowd-specific definitions, phases of crowd development, psychological aspects and a list of determinants of crowd violence. Second, control forces doctrine documents concerning crowd confrontation missions were summarized to provide a better understanding of the objectives, modus operandi, equipment and legal considerations characterizing these missions, both from a military perspective and from a police perspective. Third, the area of non-lethal weapons was explored, including an enumeration of the types of non-lethal weapons and their areas of application, as well as an identification of some of the challenges that still exist in this domain.

In addition to the literature review and based on it, an original model for the behaviour of an individual in a crowd in the presence of control forces was developed. This conceptual model is an attempt to link together into a coherent structure those variables that were identified by the literature review as significant factors influencing the behaviour of individuals in a crowd. The model is proposed as a starting point for the future research efforts of the team aiming to build a crowd control modelling and simulation tool.

Ce mémorandum technique est rédigé dans le cadre du projet de Fonds d'investissement technologique qui s'intitule: Modélisation et simulation du contrôle des foules. Ce mémorandum présente une revue exhaustive de la littérature sur le contrôle des foules impliquant des armes non létales et couvre trois sujets essentiels pour comprendre de tels systèmes. Premièrement, plusieurs aspects liés aux foules, tels que des définitions spécifiques des foules, les phases de développement d'une foule, les aspects psychologiques et une liste des déterminants de la violence des foules, ont été étudiés. Deuxièmement, un sommaire des documents de doctrine sur le contrôle des foules est présenté afin de fournir une meilleure compréhension des objectifs, des modus operandi, de l'équipement et des aspects juridiques qui caractérisent ces missions et ce, d'un point de vue militaire et policier. Troisièmement, les armes non létales sont étudiées c.-à-d. qu'une énumération des types d'armes non létales et leurs champs d'application ainsi qu'une identification de certains défis qui existent encore dans ce domaine sont présentés.

De plus, sur la base de cette revue de la littérature, un modèle original du comportement d'un individu dans une foule, en présence des forces de contrôle, a été développé. Ce modèle conceptuel tente de relier dans une structure cohérente les différentes variables identifiées dans la revue de la littérature comme facteurs influençant significativement le comportement des individus dans une foule. Le modèle est proposé comme point de départ pour les futurs efforts de recherche de l'équipe qui visent à bâtir un outil de modélisation et de simulation du contrôle des foules.

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Crowd confrontation systems, crowd control modelling and simulation, non-lethal weapons, crowd behaviour, psychology-based crowd modelling

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